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COMDTINST M13001.1
JUL - 3 2000

COMMANDANT INSTRUCTION M13001.1

Subj: USCG AVIATION FUEL HANDLING PROCEDURES MANUAL, COMDTINST M13001.1

1. PURPOSE. To promulgate the USCG Aviation Fuel Handling Procedures Manual, COMDTINST M13001.1.

2. ACTION. Area and district commanders, commanders of maintenance and logistics commands, commanding officers of headquarters units, assistant commandants for directorates, Chief Counsel, special staff officers at Headquarters, and air station commanders shall ensure that copies of the subject manual are disseminated to all affected personnel.

3. DIRECTIVES AFFECTED. None.

4. DISCUSSION. This Manual establishes minimum quality and surveillance standards, testing requirements, safety precautions, and handling procedures for the acceptance, storage, dispensing and testing of aircraft fuels at land based servicing facilities. This document does not cover shipboard fueling procedures (see Shipboard Helicopter Operational Procedures Manual, COMDTINST M3710.2C). The objective of this guide is to educate Coast Guard personnel on the safety issues involved in fuel handling operations that will hopefully lead to minimal future injury and property damage. Nothing in this Manual relieves the Air Station Commanding Officer from the responsibility of ensuring that all fueling operations are conducted in accordance with Federal, state and local regulations concerning fuel storage and transfer, and environmental protection.

5. CHANGES. Recommendations for improvements to the subject Manual shall be submitted via the appropriate chain of command using USCG Form CG-22.

6. POLLUTION PREVENTION (P2) CONSIDERATIONS. Pollution Prevention considerations were examined in the development of this directive and have been incorporated into the text as necessary.

7. FORMS AVAILABILITY. All forms mentioned in this Manual, as well as the Manual itself, are available in the AR&SC Internet Website under the Engineering and Publications Library section, or can be reproduced directly from the Manual. Forms CG-22 and DD 250 can also be accessed using Jetform Filler software.

/s/ R.F. SILVA
Assistant Commandant for Systems

U.S. Department
of Transportation
United States
Coast Guard

USCG
AVIATION FUEL HANDLING
PROCEDURES MANUAL
COMDTINST M13001.1
June 2000

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1. INTRODUCTION

1.1 PURPOSE OF DOCUMENT

This document establishes minimum quality and surveillance standards, testing requirements, safety precautions and handling procedures for the acceptance, storage, dispensing and testing of aircraft fuels. In addition, this document provides information on the nature of electrical hazards and describes how to minimize electrical problems associated with servicing operations.

The objective of this document is the promotion of safe and efficient aircraft fueling operations. Only by fully understanding the safety and procedural issues surrounding fuel handling operations, can the Coast Guard minimize the probability of injury and property damage associated with aircraft ground servicing operations, and related ground support functions.

Note: There are **WARNING** and **CAUTION** statements throughout this Manual. Review any **WARNINGS** or CAUTIONS before starting any task. For a definition of these terms see paragraph 1.7 of this Manual.

1.2 SCOPE OF DOCUMENT

This Manual applies to all Coast Guard (CG) aircraft ground servicing operations at land-based fueling facilities. Coast Guard fueling personnel shall exercise caution when refueling any non-Coast Guard aircraft. The standards and procedures in this manual have been developed with Coast Guard aircraft in mind. Nozzle pressures, refueling procedures, and grounding procedures for non-Coast Guard aircraft might differ substantially from those contained in these pages. Fueling supervisors must remain vigilant at times when refueling any non-Coast Guard aircraft.

1.3 DISTRIBUTION

This Manual will be distributed to the Commandant of the U.S. Coast Guard, the Superintendent of the U.S. Coast Guard Academy, and the Commanding Officers at the following CG organizations:

CG Air Stations:
- Astoria
- Atlantic City
- Barbers Point
- Borinquen
- Cape Cod
- Clearwater
- Corpus Christi

Detroit
Elizabeth City
Houston
Humboldt Bay
Kodiak
Los Angeles
Miami
New Orleans
North Bend
Port Angeles
Sacramento
San Diego
San Francisco
Savannah
Sitka
Traverse City
Washington National Airport
CG Aircraft Repair and Supply Center.
CG Aviation Technical Training Center.
CG Aviation Training Center.
CG Command and Control Engineering Center.
CG Engineering Logistics Center.
CG Institute.
CG Operations Systems Center.
CG Research and Development Center.
CG Reserve Training Center.
CG Training Center.
CG Yard.

1.4 ACRONYM LIST

The following acronyms are used in the Manual:

APU	Auxiliary Power Unit
ASTM	American Society for Testing and Materials

CFD	Contaminated Fuel Detector
CG	Coast Guard
CI	Corrosion Lubricity Improver
COTR	Contracting Officer's Technical Representative
DOD	Department of Defense
FSII	Fuel System Icing Inhibitor
FSS	Federal Stock System
FSSZ	Fuel Servicing Safety Zone
FWD	Free Water Detector
GPM	Gallons Per Minute
HEPCV	Hose End Pressure Control Valves
kPa	Kilo Pascal
LDC	Leak Detection Compounds
NEC	National Electrical Code
NFPA	National Fire Protection Association
NSN	National Stock Number
NSS	Navy Stock System
OJT	On the Job Training
OOC	Out of Commission
OSHA	Occupational Safety and Health Administration
PMS	Preventive Maintenance System
PQS	Professional Qualification Standards
PSI	Pounds Per Square Inch
PSID	Pounds Per Square Inch Differential
SDA	Static Dissipater Additive
SPR	Single Point Refueling
TAU	Twin Agent Unit
TSA	Thermal Stability Additive

1.5 AUTHORITY TO CHANGE

All waivers or requests for changes to this Manual will be made by Coast Guard Headquarters Aeronautical Engineering (COMDT G-SEA.).

1.6 REFERENCE DOCUMENTS

The following documents were used in preparing this Manual.

1.6.1 Coast Guard

Aeronautical Engineering Maintenance Management Manual, COMDTINST M13020.1E Change 1, February 9, 2000.
Storage Tank Management Manual, COMDTINST M5090.9, November 2, 1995.

1.6.2 Department of Defense (DOD)

Naval Air Systems Command, *Aircraft Refueling NATOPS Manual*, NAVAIR 00-80T-109, 15 May 1996.
Naval Air Systems Command, *Aircraft Refueling Handbook*, MIL-HDBK-844 (AS), 20 October 1992.
Department of the Air Force, *Ground Servicing of Aircraft and Static Grounding/Bonding*, T.O. 00-25-172, 25 July 1997.
Department of the Air Force, *Quality Control of Fuels and Lubricants*, T.O. 42B-1-1, 1 May 1997.
Department of the Air Force, *Management of Recoverable and Waste Liquid Petroleum Products*, T.O. 42B-1-23, 1 January 1995.

1.6.3 MIL-STANDARDS

Into-Plane Servicing of Fuels at Commercial Airports, MIL-STD-1548B, 23 May 1986.
Military Standard Identification Methods for Bulk Petroleum Products Systems Including Hydrocarbon Missile Fuels, MIL-STD-161F, 1 August 1977.

1.6.4 FAA

Aircraft Fuel Storage, Handling and Dispensing on Airports, FAA Advisory Circular #150/5230-4, 27 August 1982.

1.6.5 Industry Documents

Air Transport Association of America, *Standards for Jet Fuel Quality Control at Airports*, ATA Specification 103, July 5, 1996.
National Fire Protection Association, *Standard for Aircraft Fuel Servicing* (NFPA 407), 1996 Edition.

1.7 GLOSSARY

Terms used in this Manual are defined below.

TERM	DEFINITION
Aircraft Fuel Servicing	Movement of fuel to or from an external source, to or from an aircraft, including the time during which fueling connections and disconnections are made.
Bonding	Electrical connection of two or more components in a system to equalize voltage potential.
Bowser	Tank with a capacity ranging between 200 and 600 gallons of fuel.
Bright Fuel	Fluorescent appearance of fuel that has no clouds or haze.
Bulk Storage Systems	Above or below ground storage tanks equipped for receiving and transferring the product to truck fill stands and/or hydrant system operating tanks.
CAUTION	Operating procedures or practices that could result in damage to or destruction of equipment if not strictly observed.
Clear and Bright	Absence of sediment or water in the fuel.
Coalescers	Elements used to remove water from fuel. The coalescer filters stop the heavier water. The droplets then fall out of solution and collect in the bottom of the coalescer enclosure.
Coarse and Fine Particles	Solids that are larger than 10 microns (coarse) and smaller than 10 microns (fine). Coarse particles can be seen with the naked eye. Fine particles in sufficient amounts appear as haze or cloudiness in fuel.
Cold Refueling	Non-emergencies fueling of a cold aircraft either from bowser, truck or pipeline.

Concurrent Fueling	Fueling while conducting maintenance, logistics, or passenger operations.
Day Tanks	Storage tanks that contain ready to issue fuel in sufficient quantity to sustain on normal days operations.
Defueling	Removal of fuel from aircraft or other storage vehicles or tanks.
Dissolved Water	Essentially humidity in fuel that condenses and evaporates with fuel temperature resulting in a cloudy appearance.
Dry Fuel	Fuel containing no water.
Entrained Water	Water suspended in tiny droplets in the fuel.
Filter Separator Vessel	Cylindrical vessel housing coalescer and separator elements that remove solid contaminants and coalescers and separate free water from fuel.
Flash Point	The temperature at which the vapors above the fuel sample temporarily ignites without supporting continuous burning.
Free Water	Fresh or saline water completely free of fuel. Note: Free water will settle-out in fuel if not disturbed or agitated.
Fuel King	The petty officer whose primary responsibility is the receipt, storage, testing, recirculation and dispensing of aviation fuel at a CG Air Station.
FSII (Fuel System Icing Inhibitor)	Chemical compound mixed into aviation fuel to prevent water in the fuel from freezing and forming ice pellets that can clog a fuel line. Also contains microbiological growth inhibitors.
Fuel Servicing Safety Zone	Area within 50 feet of a pressurized fuel-carrying servicing component and/or within 25 feet of aircraft fuel vent outlets.
Full Flow Monitor Cartridges	Filter elements that remove free water and solid contaminants from fuel. Fuel flow is restricted or shut-off by the elements when saturated with water.

Gauge Pressure Fuel pressure measured by a pressure measurement device containing a scale calibrated in pressure units, such as psi or kPa.

GO-NO-GO Fuel Monitor A canister containing several filter elements for removing both water and particulate contamination from the fuel. As the elements become contaminated, they restrict the flow of fuel to the aircraft.

Grounding (electrostatic) A method of removing electrostatic charge building on a conductive object by connecting the conductive object to an earth ground point.

Hot Refueling Refueling an aircraft with one or more engines running.

Hydrant Servicing Unit Filtration-equipped, hydrant-hose trucks, or hose carts that convey fuel from a hydrant system to an aircraft.

Hydrant System The pumping of fuel from storage tanks through a filter separator and a manifold to lateral lines containing one or more servicing outlets. Aircraft are serviced through a hydrant hose truck or hose cart connected to the hydrant outlet located in the ramp or aircraft parking area.

May An acceptable, optional, or suggested means of accomplishment.

Microbes Microscopic growths found in soil, air, water, and fuel oil.

Micronic Filter Vessel A cylindrical vessel containing pleated paper cartridge elements for filtering micron size (1/1,000,000 of a meter) solid contaminants from fuel. Micronic filters are treated to repel water, but are not designed to effectively remove free water from fuel.

Mutagen Anything that can increase the rate of abnormal change in human cells, which can lead to cancer.

Note An essential operating or maintenance procedure, condition, or statement usually related to safety of flight, which must be highlighted.

Overwing Refueling Delivering fuel directly into an aircraft fuel tank using an overwing refueling nozzle.

Pressure Refueling Delivery of fuel directly into an aircraft via a enclosed system of hoses and pumps. Fuel is typically delivered under hi-pressure via a single point refueling (SPR) nozzle that attaches to an aircraft via a locking hose coupling.

Reclaimable Product	Product of known or determinable quality that can be used for the original grade without reprocessing, for example, JP-5 received from bowsers and returned directly to bulk or operating storage.
Recyclable Product	Product that does not meet its original specification, but which, through processing, can be recovered for the original grade or a lower grade without reprocessing, (except for settling time, filtration, and/or blending).
Refueler Tanks	Fuel tanks used to dispense fuel into aircraft (via filter/ coalescers). Refueler tanks may be fuel trucks or day tanks used to feed hydrants.
Refueling Rate	Amount of fuel in gallons per minute (gpm) or liters per minute (L/min.) at which aircraft are serviced.
Refueling Units or Refuelers	Trucks equipped with a tank, pump, filtration, and other accessories for refueling aircraft.
Shall	Mandatory requirements.
Should	Preferred method of accomplishment.
Slug	A quantity of free water in a fuel system.
Stripping	Process of removing water and other contaminants that settle out of fuel.
Surfactants	Soap or detergent-like materials occurring in fuel.
Twin Agent	A fire extinguisher that mixes fire suppression chemicals
Unit (TAU)	and sprays the combined mixture under pressure onto a fire. These units can be Crash Rescue/Fire Fighting (CRFF) vehicles, trailer-mounted dispensers, or roll around units. They typically dispense fire suppression foam such as AFFF.
WARNING	Operating procedures or practices that could result in personnel injury or loss of life if not followed.
Waste Product	Product that is no longer suitable for any use on an installation because of excessive contamination or quality degradation.
Will	Mandatory requirement; also used to express a declaration of purpose.

2. AIRCRAFT FUEL

Fire or explosion hazards are always present in locations where fuels are handled. Safe fuel service depends on keeping fuels in controlled areas, avoiding spills, and keeping all ignition sources 50 feet away from designated servicing areas and tank farms.

CAUTION: Adequate surveillance of all types of aircraft fuel is necessary. Otherwise, contamination is almost certain to result.

2.1 DISCUSSION

Most aircraft turbine engines use a variety of grades of aviation turbine fuels. The primary difference between the grades of turbine fuels is the volatility. Paragraph 2.2 describes the three grades of fuel currently authorized for use in CG aircraft. No other grades of fuel can be routinely used by CG aircraft without prior approval from Commandant (G-SEA).

CAUTION: JP-4 and JP-5 carry the same MILSPEC; use caution when ordering either product to prevent mixing.

2.2 TYPES OF FUEL

See Table 2-1 for a comparison of the qualities of authorized Coast Guard aviation fuels.

Table 2-1. Coast Guard Aviation Fuel Comparison Table

Type of Fuel	Flash Point	Freezing Point	NATO Code	Mil-Spec #	Density (API Gravity)
JP-4	-4F	-72F	F-40	MIL-DTL-5624T	36-48
JP-5	140F	-51F	F-44	MIL-DTL-5624T	45-57
JP-8	100F	-53F	F-34	MIL-DTL-83133E	37-51
JET A	100F	-40F	F-34	ASTM D 1655	37-51
JET A-1	100F	-53F	F-35	MIL-DTL-83133E	37-51
JET B	-4F	-72F	N/A	ASTM D 1655	45-57

2.2.1 JP-4

JP-4 is a blend of gasoline and kerosene with a flash point of -4 F and a freezing point of -72 F. It is procured under Military Specification MIL-DTL-5624T. It is an alternative fuel to JP-5 for turbine engine powered aircraft, and is used only at shore stations. Shipboard use is prohibited. Because of its higher volatility, JP-4 is more dangerous to handle than JP-5. The fuel vapors in the space above JP-4 fuel in the tank normally occur in the explosive mixture range and can be ignited by static electricity. In addition, JP-4 fires spread rapidly and are much more difficult to extinguish than JP-5 fires. The NATO code for JP-4 is F-40.

CAUTION: This fuel is only authorized for use in CG aircraft when JP-5 or JP-8 is not reasonably available. Keep all turbine fuels away from all sources of ignition and oxidizers. Avoid eye or skin contact. Avoid inhalation and ingestion. Wash thoroughly after handling.

2.2.2 JP-5

JP-5 is a kerosene fuel with a high flash point of 140 F and a freezing point of -51F. It can also be procured under Military Specification MIL-DTL-5624T. The higher flash point provides an increased level of safety in shipboard and shore station handling. It is the only aviation fuel authorized for use aboard cutters. It is also used extensively at shore stations. In contrast to JP-4, contamination removal from JP-5 is more difficult because of its higher viscosity and density. The NATO code for JP-5 is F-44.

CAUTION: If adequate surveillance of this type fuel is not practiced, contamination is almost certain to result. Keep fuel MIL-DTL-5624Taway from all sources of ignition and oxidizers. Avoid eye or skin contact. Avoid inhalation and ingestion. Wash thoroughly after handling. Note that JP-5 carries a health hazard and high levels of benzene.

2.2.3 JP-8

JP-8, procured under Military Specification MIL-T-83I33E, is a kerosene fuel similar to commercial jet fuel, ASTM Jet A-1, except that JP-8 contains fuel system icing inhibitor as well as other fuel additives. It is similar to JP-5 with respect to most fuel properties except the flash point, which is only 100 F. Since its flash point is not as high as that of JP-5, it cannot be used for shipboard operations. DOD is currently in the process of converting shore-based operations to JP-8 fuel in order to take advantage of its similarity to commercial aviation turbine fuel and improved safety (lower volatility). If the Coast Guard follows DOD, JP-8 may become the standard CG shore aviation fuel in the near future. The NATO code for JP-8 is F-34. FSII is required in all JP-8 fuel used for Coast Guard aviation.

2.2.4 Jet A

Jet A is a commercial grade of fuel that meets the specifications of ASTM D 1655. It is very similar to JP-5, except that it has a lower flashpoint of approximately 100F compared to the 140F flashpoint for JP-5. Jet A can be used as a replacement when JP-5 is not readily available. The NATO code number for Jet A is F-34.

2.2.5 Jet A-1

Jet A-1 is a commercial grade of fuel that meets the requirements of ASTM D 1655. It is very similar to JP-8 and has the same flash point and freezing point. Its NATO code is F-35. Jet A-1 can be used as a replacement when JP-8 is not readily available.

2.2.6 Jet B

Jet B is a commercial grade of fuel that meets the requirements of ASTM D 1655. It is very similar to JP-4 and has the same flash point and freezing point. Jet B can be used as a replacement when JP-4 is not readily available. It does not have a NATO code number.

2.2.7 Turbine Fuel Additives

Jet A, Jet A-1 and Jet B are essentially the same fuel as their military counterparts except for small, but, significant differences in volatility and fuel additives. All three military fuels contain the following additives not normally contained in commercial fuel:

a. Fuel System Icing Inhibitor (FSII).
b. Lubricity Additive (corrosion inhibitor).
c. Antioxidants (storage stability additives).
d. Static Dissipater Additive (SDA) (JP-4 and JP-8 only).

Some SDA additives can break down filter elements. Consequently, they are not added to JP-5. JP-5 fuel handling systems should have a static charge relaxation chamber at appropriate points in order to eliminate static charges.

2.3 TYPES OF CONTAMINATION

Aircraft engine failure or poor performance can be caused by fuel contamination or by using an improper fuel. There are four major classifications of contaminants commonly encountered in aviation fuels: particulates, water, microbes, and surfactants. The most serious situation occurs when there are multiple contaminants.
Paragraphs 2.3.1 through 2.3.4 describe each type of contaminant, its effect, and how it may interact with other materials to compound problems of contamination control. Paragraph 2.3.5 describes miscellaneous contaminants.

2.3.1 Particulates

Particulates are solid contaminants that will not dissolve in fuel. Most common are iron, rust, scale, sand, and dirt. Other examples are metal particles, lint, particles of filter media, gums, resins, and rubber. The consequences of particulate contamination in aviation fuels may be severe if the material is allowed to reach the aircraft. For example, if fuel filters become plugged the flow of fuel to the engine is interrupted, resulting in engine failure.

One method of removing particulates is to provide a minimum of two hours for solids to settle before the fuel is withdrawn from the storage tanks. A better method is to recirculate the fuel through filters/separators. The maximum acceptable level of particulate contamination is 2 mg/l. Particulate contamination can be held well below a level of 1 milligram per liter (mg/l) in a properly functioning fuel distribution system. If contamination exceeds 1 mg/l, corrective action should be taken to improve fuel quality. See paragraph 5.2 for contamination limits.

2.3.2 Water

Water is a common contaminant of aviation fuel and exists in three forms: dissolved, entrained, and free water (either liquid or frozen). Of these three, free water is the only form that can be drawn off or separated from the fuel. Dissolved or entrained water can, however, be reduced to free water and then drawn off or separated. The limit for water in aircraft turbine fuel is 10 ppm.

2.3.2.1 Dissolved Water

Dissolved water is essentially humidity in fuel. Like humidity in the atmosphere, it evaporates and condenses as a function of temperature. All aviation fuels have varying amounts of dissolved water depending upon the fuel composition and temperature. For example, at 60 F petroleum-based fuels will dissolve 60 parts per million (ppm) while at 30 F the same fuel will dissolve only 30 ppm. Lowering fuel temperatures will cause dissolved water to condense into water droplets and fall out of solution as entrained water. Except for changing to the free state upon temperature drop, dissolved water does not pose a problem to aircraft, and currently cannot be removed by practical means.

2.3.2.2 Entrained Water

Entrained water is water suspended in tiny droplets in the fuel. Individual droplets may or may not be visible to the naked eye, but they can give the fuel a cloudy or hazy appearance depending upon their size and number. Entrained water usually results from violent agitation between a water slug and fuel. It usually will settle out in time depending upon the droplet size, specific gravity, viscosity of the fuel, and currents within the tank. A water haze may often be found in turbine fuels.

2.3.2.3 Free Water

Free water is water completely free of fuel and may be fresh or saline. It can be accumulated by the settling of condensed moisture from the atmosphere, by the infiltration of water through fill lines, vents, or tank connections, or by the delivery of fuel containing water.
Large slugs of free water can cause an engine flameout. Ice from slugs and entrained water can severely restrict fuel flow by plugging aircraft fuel filters and other mechanisms. An adverse side effect of accumulations of undrainable water in any storage tank is the growth of microbes and a reduction of the level of the Fuel System Icing Inhibitor (FSII).

WARNING: Free water in the form of water slugs, visible water droplets, or hazy entrained water cannot be tolerated in a fuel handling system, and should never be delivered into an aircraft.

2.3.3 Microbes

Microbes are microscopic growths found in soil, air, water and fuel oil. They derive their nutrients from hydrocarbons in the fuel and add their metabolic waste products to the aqueous layer. There is considerable evidence that microbes can survive even in the absence of water. In a water storage tank, microbes may propagate at a very high rate.

Microbes usually appear as a brown slime that adheres to the inner surface of a fuel tank. Both the organisms and their products tend to collect at fuel/water interfaces resulting in mats, slimes, and sludge. If the interface happens to be maintained on or within a filter element, rapid plugging may occur. In addition, this may result in microbes getting through the filter and contaminating fuel downstream of the filter. Filter plugging may also result from the breakup of upstream fungal mats. In some cases, the organisms and their by-products have softened or destroyed the top coatings of integral fuel tanks and subsequently caused severe corrosion.

Because microbes thrive in water, a simple and effective method to prevent or retard their growth is to eliminate the water. The presence of visual microbes in fuel being delivered to an aircraft is a reliable indication of the presence of free water and the failure of fuel cleanup equipment. Note that FSII contains microbial growth inhibitors.

2.3.4 Surfactants

The term "surfactants" is a contraction of "Surface Active Agents." These soap or detergent-like materials occur naturally in fuel. They may also be introduced in the refining processes by the inclusion of additives into the fuel, or they may be washed off the internal surfaces of containers previously holding other products. Surfactants are usually more soluble in water than in fuel and reduce the interfacial tension between water and fuel; this stabilizes suspended water droplets and contaminants in the fuel. Surfactants adhere to filters/separators and reduce their effectiveness. They also adhere to metal surfaces until surfactant-rich water droplets are formed. The droplets run down the sides of fuel tanks and form puddles in the bottom or in the sumps. Surfactants in large concentrations usually appear as a tan to dark brown liquid with a sudsy-like water/fuel interface.

Surfactants alone are not a great threat to aircraft. However, because of their ability to suspend water and dirt in fuel and damage filter/separators, they are one of the major contaminants in aviation fuels.

2.3.5 Miscellaneous Contaminants

Miscellaneous contaminants include both soluble and insoluble materials. Fuel can be contaminated by mixing with other grades or types of fuels, by additives, or by other material. When contamination occurs, fuel performance can deteriorate. For example, there can be a reduction in flash point due to contamination with other fuels having a lower flash point. ***As little as, 5 percent JP-4 mixed with JP-5 will lower the flash point below the allowed minimum of 140F***. There can also be a reduction of Fuel System Icing Inhibitor (FSII) due to contamination with water. These contaminants are not naturally found in fuel and are usually introduced as a result of human error.

2.4 PREVENTING CONTAMINATION

Contamination of aircraft fuel can only be prevented by the use of proper equipment and by following proper operating procedures. Mixing different types of fuels or delivering the wrong fuel can be avoided if alert personnel follow correct procedures. Most CG Air Stations maintain only one or two types of aviation fuel, JP-5 and JP-8. While this practice helps to minimize the

problem, it does not reduce the need for vigilance. Completely separate handling facilities and equipment for each grade and type of fuel are required to prevent contamination.

3. SYSTEM EQUIPMENT

This section provides a general description and minimum requirements for equipment common to all land-based refueling systems, including mobile equipment. These requirements apply to both new and existing equipment.

CAUTION: The design and construction of certain pieces of equipment are especially critical to safety. Where National Stock Numbers (NSN) are specified, CG Air Stations shall only use the identified equipment. The components discussed in this chapter are essential to ensure quality aviation fuel is delivered to all CG aircraft.

3.1 FUEL FARMS

All CG Air Station fuel farms shall be constructed in accordance with applicable Federal, state and local regulations. All fuel farms shall use special "Ready Issue" fuel handling systems to contain and process fuel prior to fueling aircraft. (Air Stations that do not have a fixed fuel farm are exempt.) System requirements include:

A seven-day supply storage capacity.
Storage tanks with sloping bottoms, floating suction, and continuous recirculation through a filter/separator that removes both water and particulates.

Additional filter/separators to further clean and dry the fuel as it is loaded onto trucks at fill stands or as it enters and/or exits hydrant systems.
Fuel differential pressure gauges (Go-No-Go Gauges) that can shut off or slow down the fuel flow if excessive water or particulates are in the fuel. Fuel differential pressure gauges are normally installed in conjunction with filter/separators at truck fill stands, on trucks and hydrant hose carts and at direct refueling stations.

Proper care and operation of these systems will help ensure that only clean, dry fuel enters an aircraft. Stripping tanks and trucks daily will help eliminate the water buildup.
Air Stations without a fuel farm should ensure that the supplier handles fuel in the same manner. Requirements include:

Supplier trucks with safety seals on the hatches; otherwise, the fuel will not be accepted.
Routine observation and recording of pressure drops across filter separators and monitors to detect failures or problems.
Clear and bright test upon delivery.

Prevention of particulate matter (dirt) into the fuel. All openings and connections, including refueling nozzles, must have dust-tight caps or covers that remain in place at all times when not in use.

NOTE: Galvanized materials must not be used in aircraft fuel service. No copper alloys, cadmium plating or plastic materials are permitted for main fuel piping. The use of copper or copper alloys for other components shall be minimized.

3.2 STORAGE TANKS

Each grade of fuel shall be received, stored and issued in a segregated system. Systems and components used for receiving, storing, and refueling aircraft may be commercial or military systems that are designed specifically for aviation fuel use.
Most CG Air Stations have either bulk storage/truck or bulk storage/pit refueling. For CG purposes, service tanks (day tanks) and refueler tanks can be considered to have the same function.

All storage tanks shall include the following equipment:

Floating suction with means of verifying proper operation.
Inlet diffuser.
Gauge hatch with slotted tube.
Overheat shutoff and alarm.
Emergency shutoff device.
Low level devices.
Temperature and inches gauges.
Filtering device for fumes.
Access manhole (two are preferred).
Automatic high liquid level devices to prevent tank overfill.

Above ground vertical tanks shall also include the following equipment, in addition to the above:

Fixed roof (optional).
Light color epoxy coated floor and sides up to the top of the first wall panel.
Internal coatings (See MIL-STD-457B).
Cone down bottom to positive center sump with drain.

Above ground horizontal tanks shall also include the following, in addition to the above requirements for all storage tanks:
Carbon steel tanks with complete internal light colored epoxy coating.
Sloped bottom to positive sump with drains.
Non-metallic tanks not acceptable.

Access manholes equipped with an internal ladder.

Underground tanks shall also include the following in addition to the requirements for all tanks:

Double walled construction.
Non-metallic tanks not acceptable.
Alarm/detection system in the bottom of the space between the tanks.
Active cathodic protection system.
Carbon steel tanks with complete internal light colored epoxy coating.
Access manholes equipped with an internal ladder.
Manholes and other tank appurtenances extended above ground.
Sloped bottom to positive sump with drains.

Unless otherwise noted in this Manual, all CG aviation fuel tanks shall be constructed, maintained and operated in accordance with Storage Tank Management Manual, COMDTINST M5090.9.

3.3 REFUELER TANKS (DAY TANKS)

Military refuelers shall be designed and procured in accordance with MIL-T-28612E. Contract refuelers shall comply with NFPA 407.

In addition, the following minimum requirements shall be adhered to:

The refueler tank shall be made of aluminum, stainless steel, or carbon steel internally lined with a fuel compatible coating such as epoxy.

Tank construction shall be one compartment only with necessary baffles. Tanks shall **completely** drain at the low point. The tank shall be designed so that all portions are accessible for cleaning and maintenance.

Tank top openings shall be secured by plastic lock-ties and opened only for inspections and repairs. Manhole covers shall have a fusible plug or plugs; each equipped with fine screens, to provide additional emergency vapor release.

Tanks shall be configured for bottom loading. The bottom loading hardware shall include a cutoff valve, a MIL-A-25896 adapter to accept the standard SPR nozzle, and be of sufficient size to receive product at 385 gallons per minute. A fill stand anti-drive away device shall be incorporated.

Each tank shall be equipped with an electronic system for controlling the filling operations (Scully Dynaprobe or equivalent), that is compatible with the system on the station's fill-stand. It should be located near the bottom-loading adapter and incorporate an anti-driveaway feature.
The piping system, including all hardware components, shall be capable of dispensing fuel at the rated flow of 385 gallons per minute.

CAUTION: The use of swing joints with Zerk-grease fittings is prohibited since they can contaminate the fuel with grease.

Refueler trucks shall be equipped with the following:
Filter separators.
Floating suction.
Fuel pressure differential gauges.
Relaxation chambers.
Meter.
Approved aircraft refueling hoses.
Dry-break, quick-disconnect coupling.
Hose end pressure regulator.
Two approved aircraft refueling nozzles, one for refueling and one for defueling.
Bonding cable.
A minimum of two fire extinguishers, each with an ANSI rating of at least 20-B:C.
Remote, hand-held, deadman control.
Fuel/Oil Spill Kit

Tires shall be a non-FOD type with slick tread or wide lug, wide groove tread. Tread shall not have the narrow groove design in which small stones and gravel can become imbedded and later drop out on a runway or fueling pad. Recaps and slicks are not authorized on the steering wheels for off-base operation.
The exhaust of all engines shall be equipped with a suitable spark arrestor. Only manufacturer's parts shall be used in exhaust system repairs.

3.4 FILTRATION

Aviation fuel dispensed into aircraft shall pass through two filter systems downstream from bulk storage. When operating tanks are installed in conjunction with bulk storage tanks, at least one of the filtration systems shall be located downstream from the operating tanks. The initial filter may be a filter separator, micronic filter, or full flow monitor cartridge type device with differential pressure monitoring. The final filtration of aviation fuel shall be through a filter separator or full flow monitor.

The filter separator shall meet the performance requirements of API publication 1581, Group II Class B, latest edition, or MIL-PRF-52308H. Full flow monitors shall meet the requirements of IP *Specifications and Qualification Procedures-Aviation Fuel Filter Monitors with Absorbent Type Elements.* Filtration equipment shall be rated equal to or greater than the pumping capacity of the system. Filtration equipment shall be designed so that fuel bypass is not possible.

Filter/Separators must be equipped with automatic water detection systems that will stop fuel flow or alert operating personnel when actuated by a high water level. Float or electronic probe systems must include provisions for an operational test. Figure 3-1 illustrates a typical air station fuel farm configuration.

3.4.1 Filter Elements

Filter element replacement in filtration equipment is required when the following occurs:

Test results on samples taken downstream of the filtration vessel exceed 5 parts per million free (undissolved) water, 1.0 mg/l of solids, or color assessment is equal to or exceeds a 5 rating for any of the colors in the Aviation Turbine Fuel Contamination Standards (paragraph. 5.4.2.3.c).

The pressure differential across the elements at rated flow exceeds 104 kPa (15 psid) on the aircraft servicing unit and 140 kPa (20 psid) on all other vessels.

The differential pressures reading decreases 20 kPa (3 psid) or more from the previous reading when both are recorded at approximately the same flow rate.

The micronic filters, used downstream of bulk storage, reach 104 kPa (15 psid) differential or have been in service for three years or one million gallons.

The filter separator coalescer elements have been in service for three years.

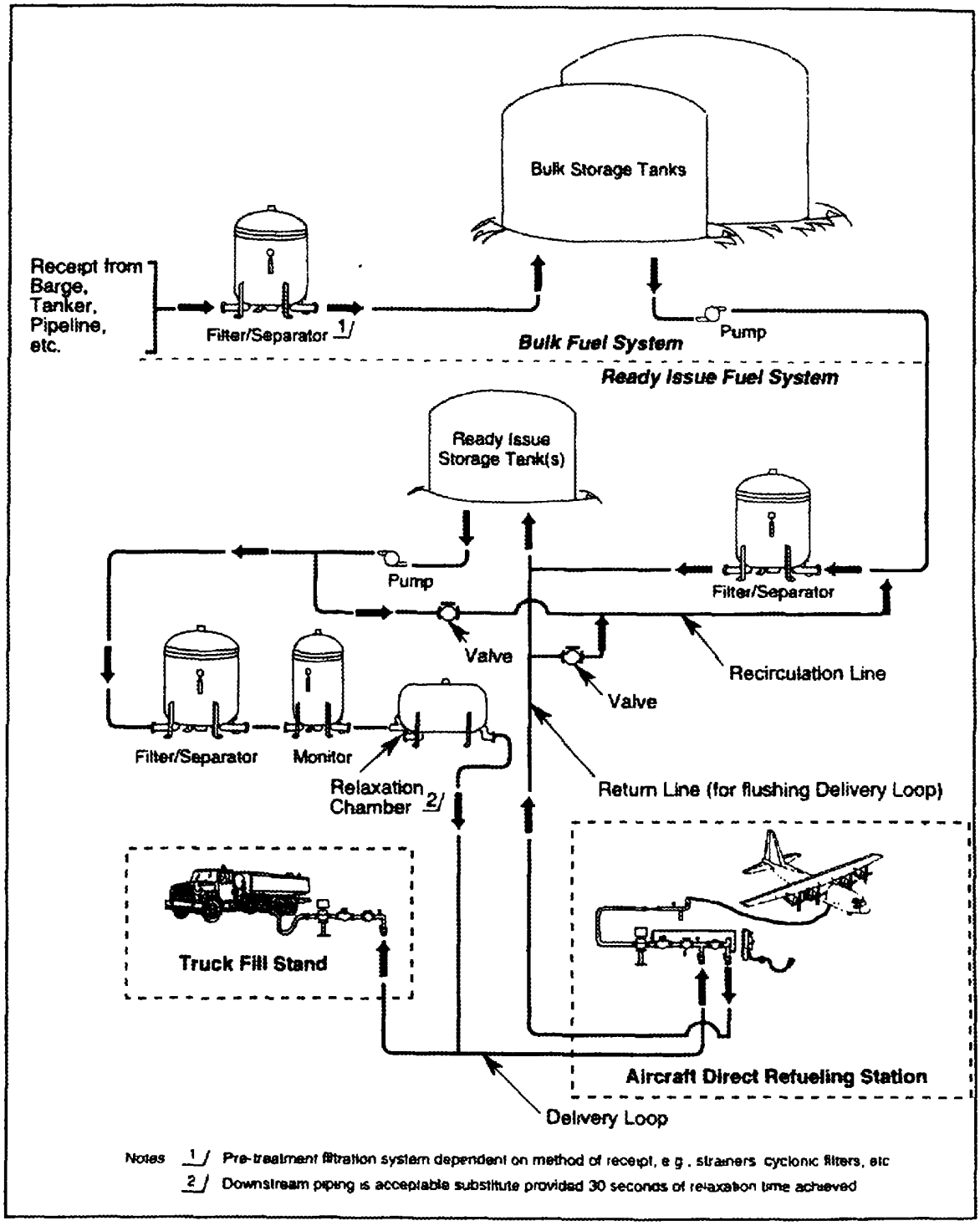

Figure 3-1. Air Station Fuel Farm Flow Schematic

A sudden drop in the pressure differential across the elements. No increase in the pressure differential after several months of operation (it should increase slowly with use).

Analysis of samples indicates inadequate filtration of water and/or solids.
Significant quantities of fibrous material are detected downstream of filter/separators.

The full flow monitor cartridges reach the differential pressure limit recommended by the manufacturer or l04 kPa (15 psid), whichever is less.

After the elements are replaced, re-circulate a minimum of 2000 gallons of fuel through the new elements to ensure the fuel is clear and bright prior to placing the system back in service. All filters/separators used for aircraft fuels shall meet the performance standards of MIL-PRF-52308. Elements shall meet the requirements of MIL-PRF-52308 or API-1581.

3.4.2 Filter Vessels
All filter vessels must be equipped with:

Provisions for elimination of air.
Direct reading differential pressure gauges.
Manual sump drain-valves with handles spring loaded to the closed position.
Upstream and downstream sampling (Millipore) connections, including probes and dust caps or plugs.
Pressure relief valves.
Placard indicating month and year of last filter change.

The use of automatic water drain valves is prohibited. Existing automatic drain valves shall be removed upon receipt of this document.

3.4.3 Strainer
Strainers provide only minimal protection for coarse solid contamination. They are usually made of wire mesh screen inside a casing. Fuel trucks have catch screens that are removed and cleaned monthly. Fuel systems have a strainer on the fueling nozzle that provides a final barrier against introducing particulate contamination into the aircraft fuel system.

3.4.4 Filter Water Separator (Coalescer)
Coalescers have two functions: filtering particles and separating water from fuel. It is usually a two-stage unit, within one enclosure. The first stage acts as a filter and coalescer while the second stage separates the resulting larger droplets from the fuel. Filter requirements include:

Sized to hold 5-micron particles.
Stenciled date of the last filter change on the filter exterior.

3.5 PRESSURE GAUGES

Pressure gauges are required for monitoring aircraft refueling operations and must be mounted where they are visible to the fueling equipment operator. Pressure gauges on aircraft refueling equipment shall be calibrated annually. Pressure gauge requirement s include:

- Minimum face diameter of 4-inches and accuracy of +/- 2% of full scale.
- Visible date of the last calibration displayed on a tag on the gauge face.

3.6 DIFFERENTIAL PRESSURE GAUGES

Filtration equipment shall be equipped with differential pressure gauges. Differential gauge requirements include:

- Capability to measure differential pressure across the vessel or across each stage of elements.
- Daily observations and weekly recording of differential pressure and flow rate for each micronic filter, filter separator, and full flow monitor.

Piston type differential pressure gauges require no calibration if the piston returns to zero under no flow conditions.

3.7 GO-NO-GO MONITORS

All aircraft fuel dispensing systems shall have a fuel quality monitor (formerly called a GO-NO-GO gauge) installed downstream of the last filter/separator. The monitor shall meet the requirements of MIL-M-81380C. There must be no bypass around this gauge. The fuel quality monitor checks the fuel for both water and particulate contamination, reducing both to acceptable levels. As the contaminants accumulate on the filter elements, the flow of fuel is reduced. Small amounts of contamination produce a gradual reduction in the flow of fuel, while large amounts stop the flow of fuel almost immediately.

CAUTION: GO-NO-GO filter elements shall be replaced when the differential pressure across the monitor reaches 20 psid. If a reduction in fuel flow or an increase in differential pressure across the monitor occurs while fueling an aircraft, a sample shall be taken from the aircraft and tested prior to resuming flight operations.

3.8 METERS

Temperature-compensated meters shall be used for quantity determination of fuel delivery to aircraft. They shall meet the requirements of NAVSUP, Publication 1, Volume II, paragraph 23087.9. All fueling meters shall be the positive displacement type and meet the calibration requirements of the national Bureau of Standards Handbook 44, Liquid Measuring Devices. Meters shall be calibrated to an accuracy of +/- 0.2% by volume at normal flow rates.

3.9 HOSES AND COUPLINGS

Fuel hoses and couplings shall comply with the requirements of API 1529, BS 3158 or MIL-H-6521. Only hose specifically constructed for aircraft fuel servicing will be used in dispensing systems.
Hose requirements include:

Restriction to one continuous section whenever possible. If sections must be added, keep to an absolute minimum.
Off the ground storage in a manner that prevents kinks.
Protection from sunlight when not in use to reduce ultraviolet deterioration. Use dust covers on both ends.
Draining of fuel from hose and capping both ends if the hose is being stored for an extended period.
Flushing any hose being returned to service after extended storage with fuel.
Fuel sampling and check for Clear and Bright and Particulate Contamination.

Coupling requirements include:

Specifically designed standard male and female screw couplings for aircraft refueling hose.

3.10 NOZZLES

Over the wing and single point nozzles shall be available as required.
Nozzle requirements include:

Installation of 100 mesh or finer screens that can be readily removed for inspection or cleaning.
Single point pressure nozzles mating to the standard aircraft-fueling receptacle must meet the requirements of MIL-N-5877E.
Swivels with the collar secured by lock rings or safety wired collar retention screws.

3.11 PIPING

Requirements for piping casings, ducts, and chases depend on whether the piping is above ground, within a building, or above ground next to a building. All piping shall be marked in accordance with MIL-STD-161F.

Piping above ground requirements include:

Stainless steel or aluminum-steel if downstream from filter separators.
Suitably cased or installed in a duct or chase unless otherwise approved.
Construction of piping ducts or chases so that a piping failure does not result in fuel liquid or vapor entering a building.
Drains on all pipe casings, ducts, and chases.

Underground piping shall be used in areas of aircraft and vehicle movement unless the piping is protected by a substantial barrier guard and anchored to protect against physical damage.
Isolation valves on the suction and discharge piping of each pump.
Check valve at the base of each fuel piping riser to automatically prevent the reverse flow of the fuel into the pump room in the event of pump seal failure, pipe failure, or other malfunction.

Piping within a building requirements:

Location within a steel casing of a pressure rating equal to that of the carrier pipe.
Casing extension beyond the building and terminating at a low point with an automatic leak detection system.
Casing must drain into a safe location.

Piping above ground exterior to buildings requirements:

Located within a steel casing.
Pressure rating of the casing equal to that of the carrier pipe.
Casing must drain into a safe location.
Automatic leak detection system at the piping system's low point(s).

3.12 THIEF PUMPS
Underground storage tanks will have thief pumps taking suction at the tank low point for water draw off. Above ground tanks will have water draw-off valves at the tank's low point.

3.13 FLOATING SUCTION HEADS
Floating suction heads are preferred over bottom suction standpipes for fuel storage tanks. All new fuel tank installations shall have floating suction heads installed.

3.14 VENTS
Storage tank vents should be of the pressure/vacuum relief type or equivalent. Filter screens should be kept clean and rust free.

3.15 STATIC BONDING CABLES
Bonding is the process of connecting two or more metallic objects using a conductor and equalizes the electrostatic potential between two or more conductive objects. The following hardware items are used to make a static bonding cable.

Clamp (part no. M83413/7-1 only).
Plug (part no. MS3493 only).
Cable (3/32 inch, NSN 4010-00-286-2681 or NSN 4010-00-575-6234 only).

Electrostatic bonding systems must have a total resistance of less than 10,000 ohms.

3.16 DUST COVERS

Dust covers or other protective devices must be used to prevent debris from accumulating on mating surfaces of hydrant couplers and aircraft fueling nozzles.

3.17 PUMPS/MOTORS

Requirements for pumps depend on whether the pump is located outside or within a building.

For pumps located outside a building:

- Location at ground level or below ground level.
- No relay pumping permitted.
- Location not less than five feet from any building opening.
- Substantially anchored and protected against physical damage from collision.

For pumps installed within a building:

- Location in a separate room with no opening into other portions of the building.
- Adequate ventilation of the pump room and containment walls.

All electrical equipment (including motors) and wiring shall comply with NFPA 70, National Electrical Code (NEC), Article 515, using Class I liquids for all applications. All electrical equipment for dispensing fuel to aircraft shall have a back-up or emergency power source in case of a power failure.

3.18 TANK TRUCKS

Tank truck requirements for fueling aircraft shall include:

- Clamps and cables for both grounding and bonding.
- At least two each 20# dry chemical fire extinguishers, one on each side and wheel chocks for added safety when parked.
- Cargo tank constructed with stainless steel, aluminum, or internally light color epoxy coated carbon steel.
- Dome covers with a forward mounted hinge and latch to automatically close and latch the cover when the vehicle moves forward.
- Watertight, fuel resistant seals and gaskets.
- Drain located at the lowest point of each tank compartment.
- Valves with handles spring-loaded to the closed position.
- Shutoff valves located inside the tank shell of the tank outlet.
- High-level shutoff systems on bottom loading tank trucks and an electronic system for controlling the filling operation.

Recirculation connections.
Even access point with slanting seals.
Fuel spill kit.

3.19 SAFETY INTERLOCKS

All mobile fueling equipment has safety interlocks for preventing the equipment from being moved until the bottom loading coupler has been disconnected from the vehicle. Vehicle brakes are applied and the engine on motorized equipment may be stopped.
Safety interlocks are activated either when couplers or single point nozzles are not in their stowed position, the pumping system is activated on tank trucks, or lift platforms are in the extended position.
Safety interlock requirements for preventing the vehicle from being moved include:

Control secured in the normal position with breakaway safety wire for interlock systems equipped with an override device.
Placards identifying normal and override control positions with a light indicating override activation prominently located in the vehicle cab.

3.20 PRESSURE CONTROLS

All aircraft fueling equipment must have separate primary and secondary pressure control devices.

Primary pressure control will protect the aircraft under constant flow conditions and from pressure surges caused during aircraft valve closure. Fueling pressure at the fuel nozzle must not exceed the maximum allowable pressure listed in the applicable aircraft flight manual. Listed for reference:

HH-65A	55 psig
HH-60	55 psig
HU-25	55 psig
HC-130	60 psig

Secondary pressure control will protect the aircraft from primary control failure. Fueling pressure at the fuel nozzle must be limited to 50 psig or less under conditions of constant flow.

CAUTION: Fueling pressure control systems shall never allow the actual fuel pressure, measured at the nozzle, to exceed the pressure indicated by the operator's gauge. The maximum pressure for Coast Guard aircraft is 55 psig. The pressures listed above are for Coast Guard aircraft. Use caution when refueling non-Coast Guard aircraft; the allowable pressures could differ substantially from those listed above.

Fuel pressure control system requirements include:

Pressure controlling hydrant pit valves.
Pressure controlling hydrant pit couplers.
In-line pressure valves.

Hose End Pressure Control Valves (HEPCV).
High fuel pressure rapid shutdown switches.

3.21 DEADMAN CONTROL SYSTEM

All aircraft fueling equipment shall be equipped with a deadman control system that reduces fuel flow to within 5% of the fuel flow rate immediately upon release of the control lever. The system shall be designed to minimize surge pressure.
Control system requirements include:

Overshoot not to exceed 5% of actual flow rate from the time the deadman control is released until the time flow stops completely.
Control valve located and designed to operate during a surface accident, power failure, or spill.
Control valve must close completely in case of a power failure.
System must be part of the valve controlling the flow of fuel to an aircraft.
Fueling operator must be able to view the fueling control panel during fueling operations.

The fuel flow control valve shall be either:

The hydrant pit valve.
At the tank outlet on a tank vehicle.
A separate valve on the tank vehicle.
On the nozzle for overwing servicing.

Deadman controls shall be designed to prevent tampering and manually securing in the open position.

3.22 EMERGENCY FUEL SHUTOFF SYSTEM

Trucks, hydrant carts, and fueling cabinets shall be equipped with an emergency fuel shutoff system in addition to a deadman control.
Shutoff requirements include:

Shutoff control accessible from the ground.
Units with a lift or platform must have an emergency fuel shutoff control accessible from the lift or platform, in addition to one accessible from the ground.
Fuel flow should be stopped by automatically closing the hydrant pit valve upon activation. The system is designed to shut off the main valve at the bottom of the tank.
Fuel flow must be stopped within a maximum 5% overrun.

3.23 IDENTIFICATION OF FUEL HANDLING EQUIPMENT

All systems will have appropriate identifying markings and symbols denoting type and grade of fuel, in accordance with the latest issue of MIL-STD-161C. Fixed and mobile equipment shall be marked in accordance with API Bulletin l542, MIL-STD-161 or with a NATO Product Identification Code.

4. INSPECTION CHECKS

CG Air Stations must test the fuel they issue to aircraft for particulate and free water contamination and fuel system icing inhibitor (FSII) content and keep accurate records of all tests and inspections. In special cases, it may also be necessary to test other fuel qualities such as flash point, API gravity, and static dissipater level. The American Society for Testing and Materials (ASTM) *Standard Practice for Manual Sampling of Petroleum and Petroleum Products*, ASTM D4057, describes testing procedures and techniques in detail. All CG Air Stations should have a copy of this document and adhere to its recommended procedures^1. The qualified Fuel King at each CG Air Station must periodically check all aircraft fueling equipment, including fueling cabinets. Daily checks should be made prior to of the first scheduled flight of the day for each aircraft. Any fueling equipment not in daily use must have all daily, monthly, quarterly and annual checks up-to-date before the equipment is returned to service. Each CG Air Station shall establish a Preventive Maintenance System (PMS) based on this Coast Guard Aviation Fuel Handling Manual. An Air Station may develop its own PMS to suit its particular systems and equipment.

Maintenance requirements described in this section are generally limited to those activities required to maintain fuel quality and safety. They do not replace or supplant PMS actions for ensuring the mechanical reliability of all equipment servicing aircraft.

For additional information on aviation fuel facility preventive maintenance checks refer to NAVFACENGCOM *Maintenance Manual Petroleum Fuel Facilities*, NAVFAC MO-230.

4.1 INSPECTIONS PRIOR TO USE

New construction, out of service facilities, and broken down equipment, that has been repaired, shall be inspected prior to acceptance or reactivation. Special attention should be given to rated capacities of hardware, pipeline sizing, drainage, accessibility, emergency controls, safety, and fire prevention features.
Before starting a major flight operation there should be inspections covering equipment performance, pipeline integrity, valve positioning, tank arrangement, and personnel assignments.

4.2 WINTERIZATION INSPECTIONS

In climates where the ground air temperature can fall below 32 F, all equipment, which can be adversely effected by freezing temperatures, shall be inspected for proper winterization measures in the early autumn.

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1 Copies are available from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187, 215-299-5400 (phone) or 215-977-9769 (fax).

Special inspections for damage should also be conducted following any storm, flood, fire, earthquake, lightning strike, suspected act of sabotage, or vandalism; when operators identify abnormal variations of performance, flow rates, pressures, or capacities. Special inspections, performed by personnel from other departments, may also be conducted by request on electrical equipment, communications equipment, buildings, security fences, roadways, and fire prevention equipment.

4.3 AIRCRAFT REFUELING CHECKLISTS

Every CG Air Station shall use daily, weekly, monthly, and annual/periodic checklists. Local checklists for individual installations or systems may be substituted provided they meet the minimum requirements of this document.

4.3.1 Daily Checklist

Daily checks shall be completed on all aircraft fuel delivery equipment in continuous use, once every 24 hours. The checks shall not interfere with or preclude operations. Table 4-1 illustrates the daily checklist form. A description of each item field follows:

1. Fire Extinguishers. Check hose and horn for signs of wear. Check lead/plastic seal on handle and pressure gauge for proper charge. Report discrepancies immediately and do not use equipment until certified. Check the date on the inspection tag.

2. Fuel nozzle. Inspect for damage. Check nose seal for cracks or nicks, outer shell for tightness to top connection, safety wire on lock bolt, handles for tightness, and flow control handle for excessive wear, cracks or breaks.

3. Nozzle Operation. Hook nozzle to bottom loading adapter or recirculation fitting and inspect the entire nozzle assembly for broken, cracked parts, or evidence of leaks. Ensure nozzles are stored with dust covers in place. On mobile refuelers, ensure that nozzles are securely stowed and not protruding from the vehicle. Storage should shield the nozzle from the elements, especially the seal and poppet areas.

CAUTION: When nozzles are allowed to hang inverted, exposed to the environment, water and dirt may build up in the bearing collar and nose seal areas.

Table 4-1. Daily Aircraft Refueling Equipment Checklist

Vehicle or Hydrant #		Meter Reading		Product	Date _____ Time _____
#	Item (See paragraph 12 3 3 1)	OK	Adjust	Repair	REMARKS
1	Fire extinguishers (in place, filled, operable, current inspection tag)				
2	Nozzle stowage dust cover and bonding cable on gravity nozzle				
3	Hook up nozzle to bottom loading adapter or recirculation fitting, and check entire nozzle assembly				
4	Hose Check entire length for cuts, cracks, abrasions and fuel saturation				
5	Static bonding cable, plug/clip				
6	Leaks (tank, piping valves pumps, etc)				
7	Emergency valves (operation of controls)				
8	Cleanliness				
9	Battery radiator, gas, and oil levels				
10	Lights reflectors rearview mirrors				
11	Drain all low point drains (tank filter-separator, monitor, relaxation chamber)				
12	Exhaust pipe and spark arresting muffler (leaks, cracks or noise)				
13	Emergency brakes				
14	Drain water from air tanks				
15	Fill hose with full pump pressure and check entire system for leaks				
16	Open nozzle valve, check hose seal for leaks, circulate fuel and check flow rate				
17	Pump (noise, overheating, vibration)				
18	Draw nozzle sample, visually inspect for water solids and color and record results	Water _____ Color _____			Sediment _____
19	Record pressure differential reading from filter-separator and monitor	Pump Pressure _____ Pump R P M _____ Flow Rate _____			Filter Pressure Diff _____ Monitor Pressure Diff _____
COMMENTS					
INSPECTOR'S SIGNATURE		SUPERVISOR'S SIGNATURE			

4. Hose. Inspect the entire length of the hose thoroughly for cuts, cracks, abrasions, blisters, and wet spots. Exposed hose reinforcement material is cause for hose replacement. Carefully check the connection between the hose and the nozzle or fittings for slippage. Any hose that has been run over by a vehicle, is bent, flattened, or kinked, or has suffered severe end pull, shall be removed from service. Check for proper storage in accordance with paragraph 3.9 of this document.

5. Bonding Cables. Ensure cables are in place and in good condition with serviceable plugs and clips intact. A similar check can be made of grounding cables if used.

6. Leaks. Carefully inspect tanks, piping, pumps, valves, couplings, and meters for leaks. If found, immediately place the system Out of Commission (OOC) until repairs can be effected.

7. Emergency Valve Controls. Check for condition and ease of operation. If operated by air or electricity, also check operation of the valve control system.

8. Cleanliness. Exterior surfaces shall be wiped clean of oil, grease and fuel. Ensure that cabinets, troughs, cabs, and any enclosure are free of fuel, dirt, cleaning material, and unnecessary items. Check fenders and mudguards to ensure adequate protection against throwing of mud and dirt on fueling equipment and rear of unit.

9. Battery, Fuel, Coolant, and Oil. Check and refill battery, engine coolant, fuel, and lube oil.

10. Lights, Reflectors, Rearview Mirrors. Ensure that lights are in working order. Check setting and operation of rearview mirrors. Ensure that no wiring in exposed.

11. Low Point Drains. Drain fuel from the manual low point drain of all tanks into a clean container. Check for clear and bright. If water is found, properly dispose of sample and continue sampling until a clean sample is obtained. Drain off all water from the bottom of all filter/separators. Do the same for the fuel monitor housing if different from the filter/separator housing. When clear fuel is obtained, check for particulate contamination on all tanks and filter separators.

12. Exhaust System. Carefully inspect the exhaust piping and mufflers for cracks, leaks, noise and proper placement. Ensure that the clean out port on the spark arrestor is covered. Flex piping in the exhaust system is not authorized.

13. Emergency Brakes. Check throw on emergency brakes to ensure there is plenty of throw on the emergency brake handle and that the brake holds.

14. Air Tanks. Drain water and moisture from air tanks. The presence of fuel in the air is cause for immediately placing the vehicle or system OOC until repairs can be accomplished.

15. Hose Leak Test. Engage pump(s) and pressurize the system, including hoses. Check for leaks. Repair any leaks before placing the system in operation. Maximum allowable recirculation time for refuelers less than half full is three minutes.

16. Fuel Re-circulation. Place the nozzle flow control handle to the fully opened and locked position and circulate fuel. Circulate through the bottom loader or the recirculation connection on another unit. Recirculate trucks at standard rpm settings to check differential pressures and flow rates. Truck recirculation must be limited to 10- minute intervals with a one-minute rest period in between to allow for dissipation of static charges. Circulate long enough to ensure that all piping downstream of the fuel monitor elements is flushed out.

17. Pump. Check operation of pump. Listen for unusual sounds. Check for vibration, overheating and leaking seals.

18. Nozzle Sample. Check for clear and bright at the quick disconnect sampling port.

19. Record Pressure Differential Reading from Filter/Separator and Monitor. With the system operating at standard RPM, check the pressure differential across the filter/separator and monitor. Record the readings.

CAUTION: Differential pressure readings shall only be made when the system is operating at standard conditions. Otherwise the accuracy of the differential pressure readings is not reliable and could prevent the correct identification of filter or element failures.

4.3.2 Weekly Checklists

Only the Fuel King, or any other personnel properly qualified to perform the Fuel King's duties, shall perform weekly checks. In addition to weekly performance, any equipment being returned to service after 72 hours or more of down time shall also be given a complete weekly check. Table 4-2 illustrates the weekly checklist form. A description of each item field follows:

Complete items one through 17 on the daily checklist.

Table 4-2. Weekly Aircraft Refueling Equipment Checklist

Vehicle or Hydrant #		Meter Reading		Product	Date _____ Time _____
#	Item (See paragraph 12.3 3.2)	OK	Adjust	Repair	Remarks
1	Complete Items 1-17 on the Daily Checklist				
2	Take samples during recirculation and test using CFD and FWD (may be conducted at different time from rest of checklist)	Particulates by CFD _____ Water by FWD _____			
3	Inspect and Clean Refueling Nozzles (SPR and Gravity)	Description of Screen Contents SPR _____ Gravity _____			
4	Inspect tires, brakes, horn, windshield wipers, steering, trailer coupling and electrical wiring				
5	Record pressure differential reading from filter/separator and monitor	Pump Pressure _____ Filter Pressure Diff _____ Pump R P M _____ Monitor Pressure Diff _____ Flow Rate _____			
COMMENTS					
INSPECTOR'S SIGNATURE		SUPERVISOR'S SIGNATURE			

Take fuel samples and check with the Contaminated Fuel Detector (CFD) better known as the AEL MK I and the Free Water Detector (FWD) or AEL MK III.

Test for FSII using the B/2 Anti-Icing Test kit, unless the fuel initially received contained 0.10 or greater percent by volume FSII. In that case, you may test monthly. (See paragraph 5.3 of this Manual for instructions on proper use of the test kits.) Clean and inspect all nozzle screens. Use compressed air when possible. Rubber particles in the screen indicate hose deterioration. Replace defective screens. Ensure replaced screens are seated properly to prevent fuel from bypassing the screen. Inspect tires, brakes, steering, lights and fifth wheel. Check brake pad contact visually. Test emergency brakes by trying to drive slowly against them.

Measure and record the pressure drop across the filter/separator and fuel monitor using a hand held gauge accurate to within 1 psi. This is to double-check the accuracy of the installed gauges. Test the primary pressure control system with the hose end regulator blocked out or removed from the system.

The refueling control valve also provides a surge pressure quick shutdown feature. In case of a quick downstream flow shut-off, the surge pilot valve will quickly close the fueling control valve to protect the fueling hardware, whether or not the deadman control is released. To prevent discrepancies between the valves, pilots must be adjusted in sequence in descending order:

HECV----------55psi
Surge shutdown----------50psi
Primary pressure control--------45psi

CAUTION: Differential pressure readings shall only be made when the system is operating at standard conditions. Otherwise, the accuracy of the differential pressure readings is not reliable and could prevent the correct identification of filter or element failures.

Refueling equipment configured with combination filter/separator and fuel monitors usually have one pressure gauge and a four position selector marked **IN, CENTER, OUT** and **OFF.** The **CENTER** position is **OUT** for the filter/separator and **IN** for the fuel monitor.

4.3.3 Monthly Checklists

The monthly checklist requires special equipment and moving of mobile equipment to a location outside of the operating area.

Table 4-3 illustrates the monthly checklist form. Requirements for filling in each field on the form are as follows:

1. Complete Daily and Weekly Checklists.

2. Check continuity of grounding cables, bonding cables, reels, and deck sockets. Measure continuity with cable in the stowed, fully extended and partially extended condition.

3. Inspect and clean all line strainers, including meter strainers. (If strainers are difficult to access, the Commanding Officer may defer line strainer inspection to a quarterly checklist.)

4. Test the anti-driveaway device installed on all refuelers.

5. Perform engine spark check at night or in a darkened garage to locate any stray electrical sparks. If there are sparks, immediately remove the vehicle from service until the condition is corrected.

6. Test maximum flow rate. The maximum flow rate for fueling aircraft is 385 GPM and the maximum pressure at the nozzle varies by aircraft. Fueling personnel should be familiar with the nozzle pressure for each type of aircraft they service.

CAUTION: If pressures exceed 55 psi or flow rates exceed 385 GPM, the equipment should be removed from service until the problems are corrected.

4.3.4 Quarterly Checks

1. Test the primary pressure control system with the hose end check value blocked out or removed from the system.

   Install a pressure gauge (0-100 psi) into the nozzle sampling connection.
   Set up system for re-circulation of fuel.
   With system operating at normal flow rate, watch the pressure gauge in the nozzle and slowly close the nozzle flow control handle until the flow of fuel is completely stopped. Keep the truck or fixed pump operating. If pressure climbs above 55 psi adjust or repair the primary pressure control system.

Table 4-3. Monthly Aircraft Refueling Equipment Checklist

Vehicle or Hydrant #		Meter Reading		Product	Date ____ Time ____
#	Item (See paragraph 12 3 3 3)	OK	Adjust	Repair	REMARKS
1	Complete daily and weekly checklists				
2	Check electrical resistance of all bonding and ground cables and reels				
3	Inspect and clean all line strainers				
4	Test anti-drive away device				
5	Perform engine spark test				
6	Test maximum flow rate				
7	Test primary pressure control quarterly				
8	Check refueling adapters				
9	Check equipment markings				
COMMENTS					
INSPECTOR'S SIGNATURE		SUPERVISOR'S SIGNATURE			

When adjusting the surge and primary pressure controls, block out the HECV. Ensure there is at least 5 psi spacing between the HECV, surge shutdown and the primary pressure control.

When testing is complete, remove the block out device, and cycle the nozzle a minimum of three times under full flow conditions. Replace hose end pressure regulator vent screen if it was removed.

CAUTION: If the pressure exceeds 55 psi, remove the equipment from service until both the primary pressure control system and hose end regulator are adjusted and/or repaired.

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2. Check refueling adapters (receptacles) using the go/no-go gauge (NSN IRW-5520-01-301-9247) or alternate go/no-go gauge (NSN 5220-01-343-1688).

CAUTION: A worn or broken adapter can cause the safety interlocks of the refueling nozzle to fail, causing the poppet valve to open and fuel to spray or spill.

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3. Ensure that all fuel handling equipment is marked in accordance with paragraph 3.23 of this document and NAVFACP-300 or MIL-STD-161C.

4. Test fuel in tanks for FSII with the B/2 Anti-Icing Test Kit if fuel initially received contained 0.10 percent FSII by volume or greater. If not, test weekly.

4.3.5 Annual/Periodic Checklists

Table 4-4 illustrates the annual and periodic record, an important historical record for each piece of refueling equipment. The checks are meant to give the refueling vehicles a thorough going-over. Frequencies listed are minimums. CG Air Station Commanding Officers may require more frequent checks of certain items based on local conditions.

CAUTION: Manhole covers are not to be opened during periodic checks. The only time that manholes are to be opened is during the interior and manhole cover inspections or filling operations for refuelers without a Scully System. At all other times they should be padlocked shut and tightly secured. This prevents foreign material from entering the tank and prevents flammable/explosive fumes escaping the refueling vehicle and finding an ignition source.

Table 4-4. Periodic and Annual Record

PERIODIC AND ANNUAL RECORD FOR YEAR: _____

Equip type & #	Spring			Summer			Autumn			Winter			Remarks
	OK	Adj	NR	OK	Adj	NR	OK	Adj	NR	OK	Adj	NR	
Brake linings/pads													
Headlight beams													
Wheel inspection													
Suspension inspect													
Calibrate pumps & meters													
Calibrate press gauges													
Body inspection													
Paint and decals													

Record Dates Performed					
	Spring	Summer	Autumn	Winter	
Oil change/lubricate					
Tank interior and manhole covers					
Winterize					
Filter element change					
Monitor element change					
Product change & flush					
Brake linings replaced					
Cabin carbon monoxide check					
Test hose end pressure regulator					
Hydrostatic test of refueling hose					
Others (List)					
Inspector's Signature					
Supervisor's Signature					

4.3.5.1 Hose End Pressure Regulators

Hose end pressure regulators for individual refueling systems shall be tested for performance and material condition annually. Do not refuel an aircraft with the regulator being tested until the test is complete and the refueling vehicle is placed back into service.

Testing procedures for the hose end pressure regulators are as follows:

1. Adjust the primary pressure control to 73-76 psi.

CAUTION: Ensure that the primary pressure control is reset to 50 psi at the nozzle before the system is placed back in operation.

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2. The HECV regulates outlet pressure to a nominal pressure of 55 psi plus or minus 5 psi. If the outlet pressure exceeds 60 psi during this testing, remove the nozzle from service and repair or replace.

3. Under flow conditions, slowly close the downstream valve for approximately three seconds. Observe the gauge for approximately 10 seconds. If pressure increases, remove the regulator and replace the seal closest to the nozzle.

4.3.5.2 Hydrostatic Testing of Refueling Hose

Conduct annual hydrostatic testing of fuel hoses, or whenever the integrity of the hoses is questionable. Hydrostatic testing shall be in accordance with ASTM D380 at a pressure of 120 psi or approximately twice the service pressure unless hoses are purchased from a supplier along with a certificate.

4.3.5.3 Filter/Separator and Monitor Pressure Log and Graph

Over time the differential pressure, commonly known as Delta-P or (triangle)P, across the filter elements will increase as more dirt and water is trapped. Each CG Air Station shall maintain a log of differential pressure for each filter/separator and fuel monitor in operation, illustrated in Table 4-5. The readings should be taken and recorded during the weekly checks. The pressure differential should then be plotted against time (Delta P on the Y-axis and time in weeks on the X-axis). This will give a clear picture of how the equipment is performing and when it needs replacement. Replace filter elements as required in paragraph 3.4.1 of this document.

Note that any rapid change (more than 1 psi/week) in differential pressure indicates filter problems (depending on the age of the filter).

Table 4-5. Filter/Separator or Monitor Pressure Drop Log

FILTER/SEPARATOR OR MONITOR PRESSURE DROP LOG

Vessel Number	Vessel Type • Filter/Separator • Monitor
Vessel Location	Vessel's Rated Flow (gpm)

Date	Pressure (psi)			Measured Flow Rate (gpm)	Calculated Differential (psi) Pressure
	Inlet	Outlet	Differential		

4.3.5.4 Storage Tanks

Every month take a fuel sample on storage tanks in accordance with paragraph 5.2.5 of this document. Inspect and clean storage tanks whenever tank samples show a continuous solids build-up or when filtration elements on the downstream side of tanks show evidence of premature plugging from excessive solids. If there is no build up or plugging, storage tanks shall be inspected and cleaned as follows.

Caution: Comply with Ashore Confined Space Entry, COMDTINST. 5100.48 (series)

Every six years for coated steel tanks and tanks constructed of materials resistant to corrosion without inlet filter separator or micronic filter.
Every eight years for coated steel tanks and tanks constructed of materials resistant to corrosion with inlet filter separator or micronic filter.

5. SAMPLING AND TESTING PROCEDURES

The major objective of any aviation fuel-handling program is to deliver clean, dry, and correct fuel to aircraft. The fuel systems of today's aircraft are complex and sensitive; they will not function properly if contaminated with dirt, water or biological matter. This section of the Manual describes minimum sampling and testing requirements for aviation fuels. Note these are *minimum* requirements and do not preclude more frequent and rigorous testing by CG Air Stations if contamination is suspected. Contaminated fuel can cause poor performance, aircraft engine failure, aircraft damage and even loss of life.

All CG Air Stations shall establish a formal fuel quality surveillance program that meets the requirements of this Manual and describes fuel-handling procedures at the particular Air Station. All Air Stations shall keep a log of fuel quality testing results. Table 5-1 is an example of the format for a surveillance log.

5.1 SAMPLING PROCEDURES

Precise sampling procedures for aircraft fuels are as important to fuel quality surveillance as precise testing procedures. Improper containers and poorly drawn or mishandled samples can generate misleading laboratory results. The person assigned to take samples should be trained, experienced, and competent in fuel sampling procedures. The basic guidelines for sampling are:

1. The sampler's hands or gloves shall be clean.

2. Samples should be as representative of the product being sampled as possible.

3. Samples of fuel being delivered to the aircraft should be taken from the fueling nozzle.

4. Samples from filter/separators should be taken at the inlet and outlet positions.

5. Samples shall be capped promptly, protected from light, and handled expeditiously.

6. Sample bottles shall be filled to within inch of the cap line.

7. Sampling connections for fixed piping systems should be installed in vertical pipe runs where practicable. If they are installed in horizontal runs, they should be placed in the side, halfway between the top and the bottom of the pipe.

8. There shall be no smoking, open flames, spark or flame producing items, or radio transmissions items within 50 feet of a sampling operation.

Table 5-1. Aviation Fuel Quality Surveillance Log

Sample		Date Tested	Sample Serial No.	Source of Sample	Test Performed					Test Results	Tester's Initials
Date	Time				VIS	CFD	FWD	API	FSII		

9. Samples shall be taken at the same flow rate and pressure as used during regular aircraft refueling. Insure that the pressures and flow rates are stabilized prior to sampling.

5.1.1 Sample Container

Sample containers shall be clear glass quart bottles for visual samples. Colored glass or stainless bottles may be used to gather samples for AEL MK I, AEL MK III, FSII tests; however, clear glass is the recommended container. Plastic, polyethylene, steel, or aluminum containers shall not be used as sample containers. Samples for lab tests shall be collected in the type of container required by the testing lab.

5.1.2 Sample Container Preparation

Sample containers shall be cleaned and inspected immediately prior to use by rinsing and flushing several times with the same fuel being sampled. The containers should be cleaned at least weekly with a laboratory glassware detergent such as Alconox (NSN 7930-01-107-9169), Alcojet (NSN 7930-01-326-8099) or Fisherbrand Sparkleen. They should be flushed with clean fresh water, dried in a warming oven, sealed and thoroughly inspected prior to use.

5.1.3 Sampling Points

The sampling point will depend on the type of storage vessel:

Tank trucks, railroad cars, and barges with multiple tanks shall have each separate tank or bay sampled on arrival at the receiving facility. The sample shall be taken from the manifold or coupling nozzle.

Storage tanks shall be sampled at the lowest point available.

Underground storage tanks may be sampled using an all levels sample method.

Fuel taken from a pipeline should be taken from a spot where the line is straight and horizontal whenever possible.

Aircraft daily samples shall be taken from all tanks using the fuel sample ports provided in the aircraft.

Refueler samples shall be taken from the nozzle.

Samples at the storage facility of outgoing fuel shall be taken downstream of the filter/separator.

5.1.4 Types of Samples

There are three types of fuel samples taken at a CG Air Station. Sample frequency varies by type of sample.

1. Clear and bright samples are taken daily from all refuelers, tank trucks and aircraft. Samples are taken in clear glass

bottles and inspected visually. No chemicals are added to the fuel for testing purposes. These samples are normally returned to the fuel system for re-use if they are not contaminated.

2. FWD, CFD and FSII test samples are taken weekly, upon receipt of fuel, or when placing a fueling system component back into operation. Samples can be taken in a clear glass bottle, a colored glass bottle or a stainless steel container. They are tested at the air station and, in some cases, test chemicals are added to the fuel sample. Fuel samples shall not be placed back into service. Instead they shall be placed into a separate tank for use in the base heating system, emergency diesel generator, or disposed of appropriately.

NOTE: When a fuel contains additives, it must meet the formula for usage regardless of whether it is required for a specific aircraft type.

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3. Lab Samples are taken monthly or when contamination is suspected or there are aircraft mishaps. Samples are taken in special containers ordered through the National Stock System (NSN 8115-00-719-4111) and are then sent to the nearest DOD fuel-testing laboratory for test and evaluation. Two samples of each specimen sent to a lab are always taken. One is retained at the Air Station until the results have been received back from the lab. This is in case a sample is lost or mishandled.

5.2 RECEIPT OF FUEL

Before unloading fuel into storage facilities the following procedures must be followed:

1. Check the bill of lading for the type, grade, and quantity of fuel.

2. Check results of any previous fuel quality tests performed by the company that made the fuel.

3. Check that all compartment seals are intact.

4. Sample each compartment of the transport and inspect in accordance with visual standards for clear and bright.

5. Check for sediment and water using the AEL MK III and the AEL MK I detectors. If contamination is detected above the allowable levels, and it cannot be removed by draining a reasonable quantity of fuel, the truck shall not be unloaded.

Note: Normally a truck cannot be returned unloaded once the seals have been broken.

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6. Ensure that the receiving tank will hold the quantity to be delivered and that contained fuel is of the same type and grade.
7. Obtain a sample of the fuel being delivered for subsequent laboratory analysis.

8. Set all valves in the storage system to make sure that the fuel will go only into the proper tank.

9. Check the receiving storage tank and filter/separator for water after each unloading and drain if required. If any appreciable amount of water is found, report it immediately to the person in charge of corrective action. Water requires time to settle, and may not be detected immediately except with FWD testing.

CAUTION: If the quality and cleanliness of the product being received is questionable, special sample shall be taken, and a complete set of fuel specification tests shall be performed before the fuel is released for aircraft use.

In addition to the routine samples that are immediately tested during fuel receipt, CG Air Stations shall obtain a one-gallon retention sample representing the shipment. This sample shall be tagged, logged, and stored in an approved flammable storage cabinet for 60 days or until the fuel is consumed.

5.2.1 Fuel Received from Railroad Car, Tank Truck or Tanker Aircraft

1. Ensure that all seals are intact and that the numbers correspond to those on the shipping document. After connections with receiving system have been made and fuel is flowing, immediately take a sample from the manifold or coupling nozzle and conduct the following tests:

   Color.
   Appearance.
   API Gravity.

2. Continue receipt of the fuel if the product is clear and bright in appearance and the API gravity is within 0.3 degrees of the shipping document (DD Form 250, *Material Inspection and Receiving Report*, or vendor's delivery invoice).

3. Take a second sample on each compartment and test for:

   Particulates (visual).
   Free Water (visual).
   Flash Point (optional, for JP-5 and JP-8 only).
   FSII.

4. Halt product receipt if any manifold sample fails the test requirements, and obtain an all-levels sample from the tank compartment.

5. Perform a CFD test on the sample if there is excessive particulate contamination. If water contamination is the issue, perform an FWD test. If the re-sample contamination exceeds 1.0 mg/l from a commercial source of 1.5 mg/l from another government source or 5 ppm water, halt the fueling. Fuel shall only be received in an emergency, if it can be determined that the filter/separator reduces the levels of contamination to acceptable levels before the fuel goes into a storage tank. In the case of compartmented vehicles, take an all-levels sample from each compartment.

6. For multiple receipts of fuel by railroad car or tank truck from the same supplier (using the same car or truck), only test the first delivery of the day for flash point, and retain a sample of the other shipments.

5.2.2 Fuel Received by Pipeline

1. Take a daily line sample and check for clear and bright.

2. Take a daily spot check and test for water and sediment using the AEL MK I and AEL MK III test kits. If the fuel samples pass, the flow will continue. If not, the fuel flow shall be halted pending further testing. The receiving tanks shall be segregated.

3. Take an all levels sample of the receiving tanks once the initial tests have been cleared and test for:

   Clear and Bright.
   FSII.
   Flash Point (optional, for JP-5 and JP-8, not required for JP-4).
   API Gravity.
   AEL MK I. Limit for water is 10 ppm
   AEL MK III. Limit for solids in 1.0 mg/l.

5.2.3 Fuel Received by Barge or Tanker

1. Take a sample before fuel discharge, at two hour intervals, and just before shutdown and test for:

   Clear and Bright.
   FSII.
   Flash Point (optional, for JP-5 and JP-8, not required for JP-4).
   API Gravity.
   AEL MK I. Limit for water is 10 ppm
   AEL MK III. Limit for solids is 1.5 mg/l.

5.2.4 Fuel Issued to Aircraft

1. Recirculate fuel in refueler trucks, direct fueling systems, or other shore-based dispensing equipment through the equipment/ system's hose and aircraft refueling nozzle and back to the tank. Do this each day before the first refueling of the day in accordance with paragraph 4.3.1 of this Manual. If refuelers are in 24-hour use they do not need to be re-circulated and shall be tested as soon as practicable every morning.

2. Sample fuel at the nozzle and test for Clear and Bright.

3. Sample each tank, on each aircraft, every day before flight operations begin. Test for clear and bright.

4. Test samples from each refueling system or equipment at least once a week for particulates and free water with AEL MK I and AEL MK III in accordance with paragraph 4.3.2, Weekly Checklists, of this Manual. Test for FSII using the B/2 Anti-Icing Test Kit. The sample must be large enough to accommodate all three tests. Fuel that has been tested for particulates, free-water, or FSII shall not be reused for another test. Recirculation and testing is required on any equipment that has not been used in refueling operations for 24 hours.

5. Daily random sampling from the refueling nozzle and testing for free water or particulates is recommended.

5.2.5 Particulate Contamination Levels

The particulate contamination level for fuel being dispensed to aircraft is 1.0 mg/l at the fuel nozzle. Daily samples taken from aircraft tanks shall not exceed 1.0 mg/l of particulate contamination as determined by the AEL MK III tester. If an aircraft fuel sample tests greater than 2.0 mg/l, the aircraft in question shall be grounded until corrective action has brought the contamination levels back into safe limits.

5.2.6 Water Contamination

The limit for water contamination in turbine fuels is 5 ppm. Fuel with greater than 5 ppm of water shall not be issued to an aircraft. If an aircraft fuel sample tests greater than 5 ppm, the aircraft in question shall be grounded until corrective action has brought the water contamination back into safe levels.

5.2.7 Correlation and Special Lab Sampling

Once a month, every CG Air Station with storage capability shall take routine correlation samples at a time when no fuel problems or aircraft problems related to fuel are known to exist. Each storage tank shall have a one gallon and one quart sample drawn on it. The gallon sample will be sent to the lab for testing. The quart sample will be retained at the Air Station until the lab results are received. A one-gallon steel drum sample container can be ordered through the National Stock System (NSN 8110-01-371-8315). The second sample is a precaution against a lost or contaminated sample. The samples shall be sent to the nearest DOD Laboratory for testing and the results of the CFD, FWD and FSII tests shall be compared to those taken at the Air Station. This will give the Air Station an additional tool to check the accuracy of its test equipment and the performance of the fuel-handling program.

Special samples are submitted for testing because the quality of the fuel or the Air Station's testing equipment is suspect. This normally takes place as the result of testing, aircraft malfunctions, or other credible reasons. Special samples have the highest priority in handling, testing, and reporting.

5.3 TYPES OF FUEL TESTS

There are three basic aviation fuel tests. The most basic is the visual clear and bright test that can be performed on the spot by qualified personnel with a minimum of equipment. More detailed tests can be conducted for dirt, water, flash point, API Gravity and icing inhibitor at the air station with testing kits. The most detailed tests are conducted at DOD testing laboratories on the monthly correlation samples and any special samples taken for cause.

5.3.1 Clear and Bright Tests

Fuel delivered to the aircraft must be clean, bright, and contain no free water. "Clean" or "clear" means the absence of any cloud, emulsion, readily visible particulate matter, or entrained water. "Bright" refers to the shiny appearance of clean, dry fuels. The terms "clear" and "bright" are independent of natural color of the fuel. Jet fuels are not dyed and may be any color from clear to amber. Ordinarily, a cloud or haze in fuel indicates the presence of water. Occasionally, a cloud denotes excessive amounts of fine particulate matter or finely dispersed stabilized emulsion. Fuel containing a cloud caused by water contamination is not acceptable if a light cloud forms when "clear and bright" fuel cools, it indicates that dissolved water has precipitated. This "precipitation cloud" represents a very slight amount of fresh water. Even this slight amount is not acceptable in fuel to be delivered to aircraft.
A "precipitation cloud" can be removed by a properly operating filter/separator; the fuel should be drained back upstream of the filter/separator and recirculated to remove the cloud. Any cloud that remains despite recirculation must be presumed to indicate a failure or malfunction of the filter/separators, a source of contamination downstream of the filter/separator, or an improperly cleaned sample container.

The clear and bright test shall be conducted:

Daily from aircraft tanks and fuel dispensing equipment.
After each recirculation of fuel, with a sample taken from the appropriate tank.
After replacement of, or maintenance on any system component with a sample from downstream of the component.
Upon receiving fuel from storage.
During Weekly and Monthly tests.
Any time when fuel condition is suspect.

During the Clear and Bright test procedure, the sample is checked for proper color and visible contamination. Then the sample is swirled to form a vortex. All free water and sediment that have settled will accumulate beneath the vortex. When a sample is being examined, move the bottle around to vary the background light. If a sample shows dirt and/or water, clean the bottle and filling equipment, flush the hose (if one is used), and conduct the test again.

WARNING: Fuel that produces samples that are cloudy, hazy or contain sediment shall not be used in aircraft.

Table 5-2 lists parameters for visual "Clear and Bright" inspection of JP-5 and JP-8 fuel.

5.3.2 Detector Kit Tests

5.3.2.1 AEL MK I

The Viewer Kit, Free Water Detector, AEL MKI, (NSN 6640-00-999-2786) is a small unit for use in the field or the laboratory to determine the free water content of aircraft fuels. It was designed for use in conjunction with the Contaminated Fuels Detector, AEL MK III, and will accurately measure trace quantities of free water in gasoline or jet fuels.

Testing procedures are as follows:

1. Pass the sample of fuel to be tested through a chemically treated 43 micron filter pad placed in the filter holder of the MK III detector. The chemical on the pad is sensitive to any free water in the fuel, producing a fluorescent pattern readily visible under ultra-violet light.

2. Examine the pad under the ultra-violet light contained in the Viewer Kit after filtration. The amount of free water in the fuel sample is determined by the intensity of fluorescence on the test pad. Visual comparison is made with a series of standards called the Millipore Scale that represent known quantities of water.

3. Take the Free Water Detector test using the AEL MK I as soon as possible following sampling.

4. Both the MK I and MK III detectors can be ordered through the Navy Supply System.

Table 5-2. Visual (Clear and Bright) Inspection of JP-5 and JP-8 Fuel

Appearance	**Contaminant**	Characteristics	**Effect On Aircraft**
Not visible.	**Dissolved water**	Fresh water only. Precipitates out as a cloud when the fuel is cooled.	**None, unless precipitating out by cooling. Then the same as entrained water.**
Light haze or cloud. May not be visible.	**Entrained water**	Tiny droplets of water suspended in the fuel; usually caused when a slug of water in the fuel is agitated, as when passing through a pump. May be settled out over time.	**Icing of fuel system. Erratic fuel quantity indications.**
Droplets adhering to the sides of the bottle. Large, visible amounts settled in the bottom.	**Free water**	May be salt or freshwater. The presence of a cloud indicates entrained water.	**Same as entrained water. Can also cause engine flameout. Salt water can cause corrosion of fuel system parts.**
Red or black powder, rouges, or grains. May appear as a dye-like material in the field.	**Rust**	Red dust is considered to be non-magnetic; black rust magnetic. Rust is generally the leading source of particulate contamination.	**Can cause fuel controls, flow dividers, filters pumps, and nozzles to clog, stick, and fail.**
Crystalline, granular, or glass-like	**Sand or dust**	Frequently present; a common source of particulate contamination.	**Same as rust.**
Red, brown, gray, or black, stringy, fibrous material.	**Micro-biological growth**	Usually found with other contaminants. Very lightweight; floats or "swims" in the fuel longer than water droplets or other particulates. Develops only when free water is present.	**Fouls fuel quantity indicator probes, flow dividers, and fuel controls; clogs filters and may cause engine flameout.**

Table 5-2. Visual (Clear and Bright) Inspection of JP-5 and JP-8 Fuel (Continued)

Appearance	**Contaminant**	Characteristics	**Effect On Aircraft**
Brown, gray, or black sticky material, variously described as gelatinous, gummy, or like catsup or mayonnaise.	**Stabilized emulsion**	Entrained water with rust or microbiological growth that stabilizes or "firms" the emulsion. Will adhere to most materials it contacts. Usually present as "globules" or stringy, fibrous material in either clear or cloudy fuel. May stand indefinitely without settling.	**Same as free water, rust, and microbiological growth, except more drastic.**
White or gray powder or paste.	**Aluminum or magnesium compounds**	Sometimes very sticky or gelatinous when present with water.	**Same as rust.**
	Surfactants	Soap or detergent-like materials that occur naturally in fuel or that are introduced in the refining process. They help suspend contaminants in the fuel and can coat filter elements, rendering them ineffective.	**Same as free water, rust, and microbiological growth.**
Cloud in fuel	**Air bubbles**	Cloud dispenses upwards in a few seconds.	**None.**

WARNING: If free water levels exceed 5 ppm, fueling operations shall be stopped. Corrective measures must be taken before flight operations can resume. Engine failure, loss of life and damage to the aircraft can result.

5.3.2.2 AEL MK III

The Contaminated Fuel Detector, Model AEL MK III, (NSN 6640-01-013-5279) is a portable field unit to determine solid contamination in aircraft fuels. The AEL MK III has a wide range covering 0-10 milligrams/liter of solids and is designed for both gasoline and jet fuels. It uses the Millipore scale with a scale range from A2 to A7, with A7 being the worst.

1. Obtain a sample of fuel to be tested in the sample bottle provided or in a clean glass or stainless steel container.
2. Filter the fuel through two-membrane 43-micron filters used in series. Solid contaminants will be collected on the top of the filter.
3. Show a light through each filter and use a meter to measure the decrease in transparency of the filters due to the trapped solids. The use of two filters eliminates errors due to variations in color of different fuels. A calibration chart is provided to convert the meter readings to contamination level in mg/liter.

WARNING: If solid contaminants exceed 1.0 mg/l, delivery of fuel to aircraft shall be stopped. Corrective measures must be taken before flight operations can resume. Engine failure, loss of life and damage to the aircraft can result. Refer to individual aircraft maintenance procedures for purging contaminated fuel. All delivery systems shall be secured until delivery of clean fuel is assured.

The AEL MK III CFD unit will enable CG Air Stations to determine the solids content of aircraft fuels. Although simple to use, it is a precision instrument and should be treated accordingly. The unit should be used for, but, not necessarily limited to the following inspections:

Fuels received into storage tanks.
Daily monitoring of filtration equipment.
Daily spot-checks on the fuel at aircraft dispensing nozzles.
Checks of any suspect fuel.
Trouble shooting equipment.

Refer to the technical manual, Contaminated Fuel Detector, AEL MK III, and NAVSHIPS 315-0145, for additional operating details.

5.3.2.3 Fuel System Icing Inhibitor (FSII)

The B/2 Anti-Icing Test Kit Refractometer contains two FSII scales, one for each of the FSII compounds currently in use. All JP-5 fuel tested shall be assumed to contain the high flash point type of FSII material, Diethylene Glycol, Monomethyl Ether, or DiEGME, which is read off of the scale on the B/2 Refractometer marked "JP-5" or "M."

If the FSII level drops below 0.08% by volume, the Air Station Commanding Officer must be notified. Each pilot of aircraft using the fuel should consult the aircraft flight manual and follow the special operating instructions to avoid safety of flight problems induced by ice. Transient aircrews, USA, USN, USAF, USMC and foreign military aircraft shall be notified if the FSII level falls below 0.08% by volume. This will allow them to consult their appropriate technical directives for special operating directives for special operating instructions to avoid water ice induced problems.

CAUTION: Failure to properly notify air crews of a low FSII condition can lead to safety of flight problems.

Unless specifically exempted, all USCG aircraft shall use FSII as a fuel additive in normal day-to-day operations. FSII prevents the formation of water and ice in fuel systems, and acts collaterally as a biostat preventing microorganism growth. Microorganism growth in fuels cells can cause considerable damage to the aircraft fuel systems, and bulk fuel storage systems.

WARNING: FSII contains mutagenic materials that are toxic to humans in their neat state. Once mixed with fuel they are safe if the fuel is handled in an appropriate manner.

5.3.3 Flash Point Test

The flash point is the temperature at which the vapor above the fuel sample temporarily ignites. The Pensky-Martens, ASTM Method D93, is the only procedure for determining flash point that is authorized at CG Air Stations. The test stand must be sitting on a steady, level surface. The room or compartment must be draft free. The test stand must be surrounded on three sides by a fire containment shield that is 18-24" high. Thoroughly dry and clean all parts before starting the test. During the testing, ensure that all fuel samples in the vicinity are tightly capped and that the test is conducted under an exhaust hood.

1. Determine the flash point by pouring a small amount of fuel into the sample container provided with the Pensky-Martens kit.
2. Heat the sample slowly at a constant rate, stirring all the time.
3. Direct a small flame into the cup at regular intervals.

The temperature of the sample at the start of the test should be 60-75F. This means that in some instances the sample may need to be refrigerated. MIL-T-5624T lists the flashpoint of JP-5 as 140F and MIL-T-83133E lists the flashpoint of JP-8 at 100F. Correcting the flash point for barometric pressure is optional except when comparing correlation test results or in the case of a disputed flash point reading. In that case, the flash point should be corrected using the following formula:

Corrected Flash Point = F + 0.06 (760-P)

(Where F is the observed flash point temperature in degrees Fahrenheit and P is the ambient atmospheric pressure in mm)

5.3.4 API Gravity Determination

The API Gravity check is used to determine volume correction and aircraft fuel weight. The measurement is most accurate when the temperature is near the standard of 60 degrees F. The hydrometer and cylinder used for the test should be approximately the same temperature as the fuel sample.

1. Pour the sample into the clean graduated cylinder.
2. Place the cylinder containing the sample in a vertical position in a location free from drafts.
3. Lower the hydrometer into the sample. When it has settled, push it down about two scale divisions into the fuel, and then

release it. Gently spin the hydrometer when releasing it. Allow the hydrometer to become stationary and all air bubbles to come to the surface.

4. Read the hydrometer to the nearest scale division. The correct reading will be at the meniscus of the fluid. Record the temperature to the nearest degree F. (See Figure 5-1)

5. Correct the observed API Gravity reading using ASTM D1250, Volume II, Table 5B for JP-5 and JP-8 fuels. Volume Table 6A is used for JP-4 fuel. Record the observed API Gravity/Temperature and API Gravity corrected to 60F.

6. To correct measured volume to 60F net volume, use ASTM 1250, Volume II, and Table 6B for JP-5 and JP-8. Use Volume I, Table 6A for JP-4 fuel.

5.3.5 Static Dissipater Additive Sampling and Testing

The EMCEE fuel conductivity meter (NSN 6630-01-115-2398) is a simple method of measuring the electrical conductivity of aviation fuel that may have supplementary Static Dissipater Additive (SDA). Coast Guard aircraft are not required to use fuel with SDA and therefore have no reason to routinely test for conductivity. In the event that the fuel king believes there is a conductivity problem, a special SDA test can be requested. Ensure that the request briefly explains why the test is required.

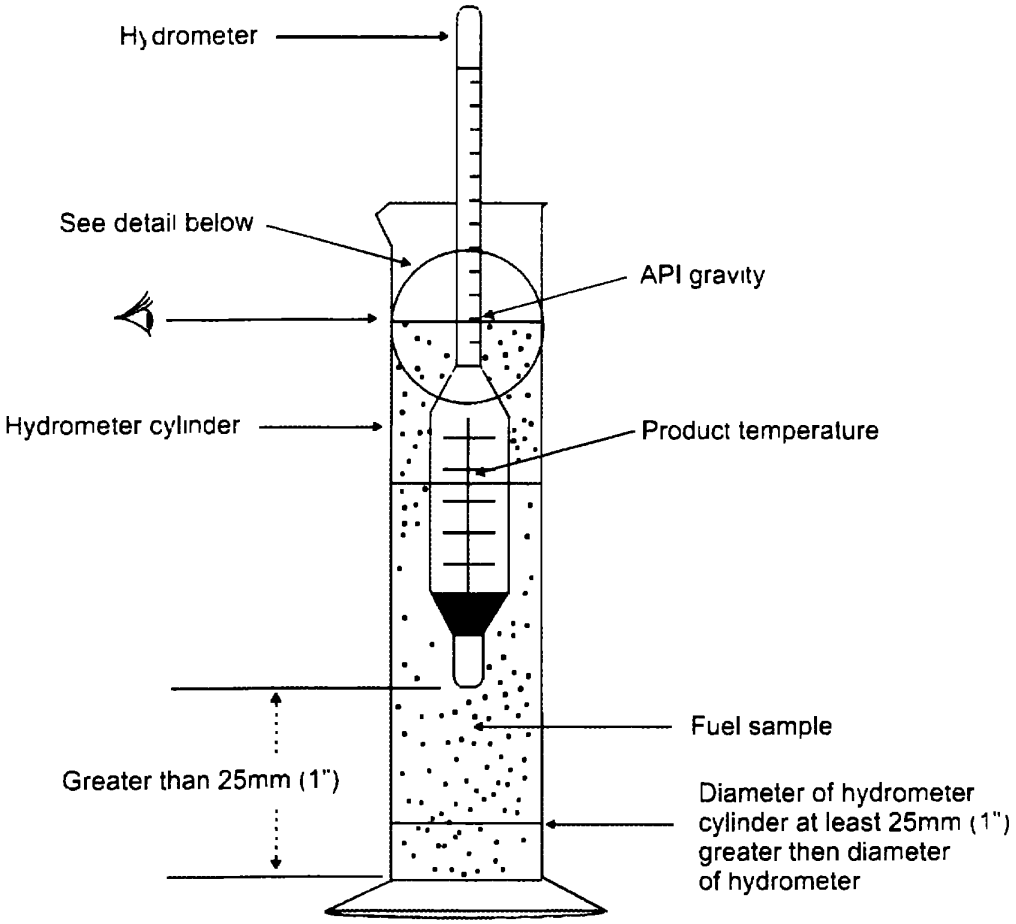
5.4 CG AIR STATION LABORATORY TESTING

Each CG Air Station that refuels aircraft shall have a designated laboratory where the in-house inspections can be performed in a clean, safe environment. The lab must meet all the requirements of the National Fire Protection Association (NFPA). As a minimum, the lab shall have the following:

1. An approved, ventilated laboratory style fume hood large enough to cover the test bench

2. Impermeable tabletops and floor.

3. An audible fire alarm.



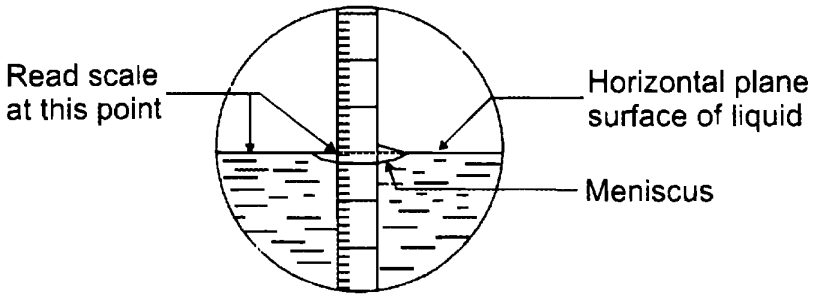


Figure 5-1. Reading the API Gravity Hydrometer

4. A fire blanket.

5. An approved fire extinguisher.

6. Explosion proof lights and switches.

7. Grounding straps.

5.4.1 Testing Equipment
Each CG Air Station that refuels aircraft shall maintain a laboratory with the test equipment listed in paragraphs 5.4.1.1 through 5.4.1.5 of this Manual. Refer to MIL HDBK-844 (AS) for overall instructions in using test kits. Refer to the operating manuals for individual test kits for more detailed instructions. Replacement manuals can be obtained from the U.S. Navy through NAVAIR (AIR-4.4.5).

5.4.1.1 Sediment Test Equipment
Contaminated Fuel Detector (CFD) or AEL MK III kit
Currently, the only CFD being procured is the CCFD, NSN6640-01-013-5279. It includes a built in FWD viewer kit. The regular CFD, NSN 6630-00-706-2302 is still available and may be used.
Additional materials needed to conduct the tests include:

Filter element, fluid, 0.43 micron-NSN 6630-00-877-3157
filter, and wratten-NSN 6630-00-849-5288:

5.4.1.2 Water Content Test Equipment
Viewer Kit, Free-Water Detector (FWD) or AEL MK I (NSN 6640-00-999-2786)
Additional materials needed to conduct the test include:

Detector pad, free water-NSN 6640-00-999-2785.
Standard, free water-NSN 6640-00-999-2784.

NOTE: Free water standards deteriorate with exposure to ultraviolet light and need to be replaced every six months.

5.4.1.3 Fuel System Icing Inhibitor Test Equipment
B/2 Anti-Icing Test Kit or FSII Refractometer
Reference NSN 6630-01-165-7133.

5.4.1.4 API Gravity Test Equipment
API Hydrometers and a 1,000 ml clear glass graduated cylinder

Reference:

Hydrometer, graduated 29- to 41- degree range, JP-5/8, NSN 6630-00-242-9258.
Hydrometer, graduated 39- to 51- degree range, JP-5/8, NSN 6630-00-245-8376.
Hydrometer, graduated 49- to 61- degree range, JP-4, NSN 6630-00-245-8377. *Note: this item is only required at Air Stations that regularly dispense JP-4 fuel.*

5.4.1.5 Flash Point Test Equipment
Pensky-Martens closed cup flash point tester
Reference NSN 6630-00-530-0987 and propane cylinder, NSN 6830-00-684-3041.

5.5 DOD LABORATORY TESTING
Take routine fuel samples monthly. These samples serve two purposes. They assist the Air Station in monitoring the performance of their local fuel-testing laboratory. They also provide DOD with information on the general quality of the fuel delivered to aircraft and the performance of AEL MK III and FSII detector kits.

The following aircraft fuel sampling containers and shipping containers conforming to MIL-K-2374 are available in the military and civilian supply system. These sampling kits meet all requirements for shipment of aircraft fuels by military and commercial transportation media.

Fuel Sampling Kit, complete, NSN 8115-00-719-4111.
Top and bottom cushioning (inner-pack) NSN 8115-00-719-4825.
Replacement Kit containing four (4) sample tags and four (4) glass sample bottles, 32 oz. Size - NSN 8115-00-717-8572.

5.5.1 Sample Container Identification
Accurate record keeping is necessary so that the test results may be correlated with the samples submitted. The following is a suggested guide for sample identification and labeling:

CG Air Station name and address.
CG Air Station sample serial number.
Type Fuel (e.g. JP-5, JP-8).
Date and time sample taken.
Location of sampling point (e.g., nozzle sample, refueler no. 3).
Name of person drawing sample.
Classification of sample and testing required.

For a special test, attach comments describing the type of test requested and a brief explanation why the test is required. This will assist laboratory personnel in determining which additional tests should be performed.

5.5.2 Shipping Instructions

Samples should be forwarded to the nearest DOD testing laboratory by the most expeditious means. See Table 5-3 for a current list of DOD Fuel testing labs and their addresses. A current list is also maintained in MIL-HDBK-844 (AS). Wherever possible, deliver samples to the laboratory by overnight courier. Samples shipped by military aircraft shall be packed according to *Packaging and Handling of Dangerous Materials for Transportation by Military Aircraft* (38-250/NAVWEPS) and the U.S. Coast Guard Hazardous Waste Manual, COMDT Inst. 16478.1B, CH-1 3/25/92.

Table 5-3. DOD Fuel Testing Laboratories

Location	Lab Shipping Address	Lab Mailing Address
Norfolk, VA	U.S. Navy Fuel Department Petroleum Testing Laboratory Craney Island Terminal 4501 Cedar Lane Portsmouth, VA 23703-207 (757)322-9090	Commanding Officer Fleet & Industrial Supply Center Code 700 1968 Gilbert St., Suite 600 Norfolk, VA 23511-3392 (757)322-9003
Jacksonville, FL	Director, Fuel Department Fleet & Industrial Supply Center 8808 Somers Rd., Bldg. 56 Jacksonville, FL 32218-2600 (904)696-6556	Same as Shipping Address
Searsport, ME	Director Aerospace Fuels Lab Det. 20, SA-ALC/SFTLB Trundy Rd. Bldg. 14 Searsport, ME 04974-0408 (207)548-2451	Director Aerospace Fuels Lab Det. 2D, SA-ALC/SFTLB Det. 20 PO Box 408 Searsport, ME 04974-0408 (207)548-2451
Dayton, Ohio	Director Aerospace Fuels Lab Det 13, SA-ALC/SFTLA Area B, Bldg 70 Wright-Patterson AFB, OH 45433 (513)255-5687	Director Aerospace Fuels Lab Det. 13, SA-ALC/SFTLA Wright-Patterson AB Dayton, OH 45433-6503 (513)255-5687
Tampa, FL	Director, Aerospace Fuels Lab Det. 21, SA-ALC/SFTLC (FP2072) 5311 No. Boundry Blvd. Bldg. 1121 MacDill AFB, FL 33621-5005 (813)828-3645	Director Aerospace Fuels Lab Det. 21, SA-ALC/SFTLC PO Box 6051 MacDill AFB, FL 33621-6051

Table 5-3. DOD Fuel Testing Laboratories (Continued)

San Diego, CA	U.S. Navy Petroleum Laboratory Point Loma Subbase 199 Rosecrans Bldg. 50 San Diego, CA 98366 (619)553-1326	Commanding Officer Fleet & Industrial Supply Center Code 700 937 North Harbor Dr., Suite. 480 San Diego, CA 92132-0480 (619)556-8123
Seattle, WA	Commanding Officer Manchester Fuel Laboratory 7501 Beach Drive East Port Orchard, WA 98366 (360)476-2135 X239	Commanding Officer Fleet & Industrial Supply Center Code 700 467 W. Street Bremerton, WA 98314-5100 (360)476-3724
Mukilteo, WA	Director, Aerospace Fuels Lab Det. 35, SA-ALC/SFTLD Ten Park Avenue C, Bldg. 1 Mukilteo, WA 98275-0046 206-355-4122	Director, Aerospace Fuels Lab Det. 35, SA-ALC/SFTLD Ten Park Avenue C, Bldg. 1 Mukilteo, WA 98275-0046 206-355-4112
Pearl Harbor, HI	Commanding Officer Fleet & Industrial Supply Center Fuel Dept., Code 700 1942 Gaffney St., Suite 100 Pearl Harbor, HI 96860-4549 (808)473-0239	Same as Shipping Address

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6. FUEL PREVENTIVE MAINTENANCE PROCEDURES

No single step or process can ensure product cleanliness. Fuel maintenance must be a continuous and progressive operation from refinery to aircraft. All clean up steps shall be performed concurrent with fueling operations.

6.1 RECEIVING FUEL

6.1.1 Procedures

The following procedures shall be followed before loading fuel at Coast Guard Air Stations with a storage tank(s).

1. Check receiving tank levels.
2. Ensure that all alarm systems are in place and operational.
3. Strip receiving tanks to ensure no free water is present.
4. Conduct all tests for receipt of fuel required in paragraph 5.2 of this Manual.
5. Allow the fuel carrier to sit stationery at the unloading point for long enough to permit water and particulates to settle. Allow at least 30 minutes.
6. Electrically bond the carrier to the fuel receiving equipment.
7. Ensure there is at least one each 20# dry chemical fire extinguisher on each side of the carrier. In addition, one 40# dry chemical fire extinguisher shall be within 30 feet of the receiving tank.
8. Check all fittings for tightness to ensure no leaks and no contamination will be introduced into the fuel.
9. Check valve alignment for proper set up.
10. Check to see that all containment walls are in place and are not damaged. Ensure that all water, and other fluids or debris, are removed from containment areas.
11. There shall be no smoking, open flames, spark or flame producing items, or radio transmissions items within 50 feet of a fueling operation.
12. Remove all unnecessary personnel from the area.
13. Check seals on carrier tanks to ensure no tampering has taken place.
14. Check weather report to ensure no lightening storms are within five miles of the fueling area.

6.2 MAINTAINING FUEL

Once the fuel is on board and in the system, it must continue to be maintained. The following procedures should be considered minimum guidance and may be supplemented by individual Coast Guard Air Stations to meet the needs of local conditions and circumstances.

6.2.1 Settling

After receipt of fuel, allow at least three hours of settling time per foot of fuel depth above the settling line before stripping the tanks of any free water.

6.2.2 Stripping

Procedures are as follows:

1. Strip all service tanks daily before recirculating.

2. Strip all storage tanks weekly before recirculating. Increased frequency of stripping may be required if fuel tests indicate an elevated free water contamination level.

3. Strip storage tanks before transferring fuel to the service tanks.

4. Ensure flow rate is sufficient to pull water and other contaminants (56-gpm minimum) out with the fuel.

6.2.3 Filtration

Filter/separators remove contamination from fuel. Even fuel that tests clean should be circulated through the filter/separator periodically. Procedures are as follows:

1. Ensure all water is drained from the filter/separator after every recirculation.

2. Change filter elements every three years, every one million gallons, or when the pressure differential (delta P) across the filter/separator exceeds 15 psig. A sudden drop in delta P across the filters indicates that one or more filter elements have failed and the filter elements should be replaced.

6.2.4 Recirculation

The filter/separator should be a part of the recirculation loop for fuel in service tanks and storage tanks.
Procedures are as follows:

1. Run fuel being dispensed to aircraft, fueling vehicles, or a pipeline through the filter separator.

2. Circulate contaminated tanks until the fuel meets the minimum requirements of the test.

3. Fuel being received by pipeline or truck does not need to be received through the filter/separator. However, the tank(s) that received the fuel should be recirculated within 24 hours.

4. Recirculate storage tanks through the filter separator once a week.

5. Recirculate the service tank daily.

6.2.5 Storage Time Limits

There is no practical limit on the time JP-5 & JP-8 can be stored provided it is properly maintained. Military fuels contain additives to prevent the breakdown of certain characteristics. However, fuel stored containing water will eventually lose part or all of its FSII content and become unusable. Commercial grade fuels should not be stored for longer than three months.

6.2.6 Records and Logs

Procedures are as follows:

1. Maintain accurate records of fuel quantity, condition, and age.

2. Maintain complete and accurate operating logs for all phases of fuel handling operations to fit the particular needs of each Coast Guard Air Station. Entries should include the daily, weekly, monthly, and annual checks along with information on facility maintenance, fuel receipts, inventory, and delivery.

6.3 FUEL ADDITIVES

Aviation fuels for use in Coast Guard aircraft may contain one or more additives that are normally added at the refinery or the DOD facility from which the fuel is purchased. Coast Guard Air Stations are not authorized to blend additives into fuel except in emergency, or as noted in paragraph 6.6 of this Manual.

6.3.1 Icing Inhibitor (FSII)

JP-5 and JP-8 fuel received from military sources will normally contain Fuel System Icing Inhibitor (FSII). FSII is mandatory for routine use in all CG aircraft. The normal level of FSII in the fuel is 0.08 to 0.20 percent by volume. The only material currently authorized for use is Di-Ethylene Glycol Monomethyl Ether (diEGME).

FSII lowers the freezing point of free water in the fuel of the aircraft. This prevents the formation of ice in the aircraft fuel system that can clog the fuel system and cause aircraft engine failure from fuel starvation. FSII also restricts bacterial growth; however, it can be broken down by the presence of free water.

WARNING: FSII is a mutagen in the undiluted state.

6.3.2 Corrosion Lubricity Improver (CI)

A combination lubricity improver and corrosion inhibitor additive is present in all military turbine engine fuels and is available as an optional additive in most commercial grade fuels. CI is added at the refinery to improve the lubricating characteristics of the fuel. Long term use of fuel oil without CI will cause engine damage. There is no required testing for CI.

6.3.3 Static Dissipator Additive (SDA)

JP-4 and JP-8 fuels are injected with a special additive that increases the fuel's conductivity and helps reduce static electrical charges produced during fuel handling operations. SDA is not added to JP-5 because when the two are combined, they tend to have an adverse effect on filter/separator performance. There is no required testing for SDA. Coast Guard aircraft do not use SDA.

6.3.4 Thermal Stability Additive (TSA)

Thermal Stability Additives (TSA) can raise the flash point of turbine engine fuels and increase their storage life. Also known as anti-oxidant additives, TSA's are added at the refinery. They are normally only found in fuels for military applications because military fuels are held in storage longer than commercial fuels. During longer periods of storage, some properties of the fuel, including its thermal stability, can break down. The flash point may also be lowered and the fuel becomes more volatile. TSA can remedy other unacceptable property changes encountered during long storage periods such as total acid number, copper strip corrosion, and existent gums.

Since the Coast Guard does not normally store fuels for long periods, the use of TSA is not mandatory. However, with prior authorization from ARSC, TSA may be added to JP-8 fuel to provide thermal stability above 100Fahrenheit.

6.3.5 Plus 100 Additive

This additive for high performance jet aircraft is usually added at the refinery or at the DOD storage and handling facility. Currently, Coast Guard Aircraft do not require the use of Plus 100 additive.

6.3.6 Leak Detection Additives

Chemical Leak Detection Compounds (LDCs) are occasionally added to aviation fuel, by aviation mechanics, to pin down the source of fuel leaks. LDCs can be harmful to the fuel and the aircraft if not used properly. The only LDCs authorized for use in Coast Guard aviation fuel are made by Tracer Research Corp., 3755 North Business Center Dr., Tucson, AZ 85705. Tracer brands A, E, N, R, and W injected in a maximum concentration of 10 ppm, may be used for leak detection. Refer to the manufacturer's instructions for procedures on mixing and adding LDCs.

6.4 CLEANING TANKS

6.4.1 Procedures

The USCG Confined Space Entry Manual, COMDT INST. M5100.48 shall be followed during tank cleaning procedures. As a minimum the following procedure shall be adhered to:

1. Leave the tank open for at least one hour to vent any toxic fumes. Before entering any tank, confirm that the tank is free of toxic vapors. Ventilate the tank with portable fans if necessary.

2. Use of an airline respirator is mandatory.

3. There shall be no smoking, open flames, spark or flame producing items, or radio transmissions items within 50 feet of a cleaning operation.

4. A safety observer shall be standing by at the tank manhole in case of an emergency.

5. The person entering the tank shall wear a harness and a safety line that can be handled by the safety observer.

6. Drain all fuel from the tank as thoroughly as possible.

7. Wash the tank with common bleach and rinse with high-pressure cold fresh water before it has a chance to dry. Do not use steam, it can damage the tanks coating system.

WARNING: Do not use the service or transfer system to drain water from the tanks after washing. Excessive contamination will result.

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8. Drain and dry the tank using the stripping system or a portable air driven pump. When dry, close the tank and re-fill it with JP-5 or JP-8 fuel.

9. Recirculate the fuel until it is clear and bright and passes the MK I and MK III tests.

10. Flush all lines, pipes, and fittings before placing the system back in service.

6.5 CHANGE OF PRODUCT GRADE

6.5.1 Procedures

To convert from JP-5 to JP-8 service, or vice versa, the following steps shall be taken:

1. Completely empty refueling unit or storage tanks and drain sumps, filter housing, and hoses.

2. Flush units/tanks with the new fuel product and drain. It is not necessary to flush out large storage tanks.

3. Inspect tanks for sludge and remove any found.

4. Change filter/separator elements.

5. Change the refueler unit's markings to the new grade of fuel and change the servicing controls as necessary.

6. Fill the refueler with the desired product and circulate 500 gallons through each hose.

7. Obtain a flow sample and test for flash point. If the test indicates a minimum flash point of 136F for JP-5 or 100F for JP-8, servicing may proceed. If not, continue recirculating through the hose and testing flash point until the desired readings are obtained.

6.6 ADDITIVE BLENDING

Fuel additives will normally be blended at the refinery, the DOD fuel farm or commercial facility from which the fuel is purchased. Additives should only be blended by qualified fuel servicing personnel when the purchased fuel does not contain the desired additives.

6.6.1 Procedures

The two basic methods for putting additives into fuel are manual (hand doping) or proportional injection. The preferred method is proportional injection using a fuel-driven design that injects additives proportionately at various flow rates. Always draw samples for receipt testing before blending additives.

There are several techniques for hand doping additives:

Blend additives into bulk airfield tanks by pouring the required quantity of additive into the tank heel before receiving fuel. This method works best if there is some fuel already in the tank. Blend the required quantity of additive into tanker trucks before unloading these trucks into the bulk system. Note: This method will not work on some tankers.

Blend additives into a refueling unit that is approximately 1/3 full by introducing the required amount through the top hatch using a funnel and a length of hose. One end of the hose should be submerged below the surface of the fuel. Finish filling the unit after putting in the additive. Wait for approximately 10 minutes and then circulate the fuel for at least three minutes before servicing the aircraft. If additives are put into a full refueler, circulate at least 150 percent of the refueler capacity before issue. In all cases where hand doping is performed, additive should be first diluted with the fuel. The greater the dilution, the easier it is for the additive to be mixed properly.

Add FSII using the 590 ml (20 ounce) aerosol can during over-wing refueling. Determine the fuel load and calculate the amount of additive required. It should be added gradually during filling to permit proper blending in the fuel. One 590 ml. can of aerosol additive will inhibit 180 gallons of fuel to 0.087% by volume.

Always wear a respirator, rubber gloves, rubber apron and safety goggles when handling additives. If additives are splashed on exposed skin or eyes, flush with copious amounts of fresh water and seek medical attention. If additives are accidentally ingested, induce vomiting and seek medical attention.

WARNING: Many fuel additives, including PRIST, are mutagens, and must be handled with great care.

6.7 WATER BOTTOMS

The use of aviation fuel tanks with water bottoms is prohibited at Coast Guard Air Stations. All fuel storage tanks shall have sumps for collecting and stripping accumulated water. Units shall check and drain sumps at least weekly. Tanks with open floating roof designs shall be stripped daily.

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7. AIRCRAFT FUELING OPERATIONS

CAUTION: Use caution when refueling non-Coast Guard or any unfamiliar aircraft. Always confirm procedures and servicing standards with the aircraft crew before commencing fueling operations. Fueling pressures and procedures could differ substantially.

Aircraft fuel servicing is potentially one of the most hazardous of aircraft ground operations. The fueling process generates electrostatic charges that can produce sufficient electrical energy to ignite any explosive fuel/air mixtures present. Fueling personnel must make a conscious effort to remove the potential for ignition by eliminating or equalizing these electrostatic charges through appropriate grounding and bonding procedures on aircraft, fuel trucks and personal clothing. A minimum of two people is required for every fuel transfer operation. The following paragraphs describe specific minimum actions to be taken when performing the various fueling evolutions. Each paragraph is designed to be a stand-alone paragraph for ease of finding instructions specific to the evolution at hand. Therefore, some repetition has occurred.

7.1 GLOBAL REQUIREMENTS

Commanding Officers Shall:

1. Review all refueling plans at least yearly.

2. Insure that the local fire department is fully informed on air station hot refueling procedures, positioning of aircraft, available air station fire fighting resources, and response plans.

3. Insure that the local fire department is alerted to all hot refueling events.

7.2 COLD REFUELING

7.2.1 Personnel Requirements

Cold refueling an aircraft from a hydrant, refueler (cart), or truck requires two people. One person is the truck driver/fuel system operator. The driver/operator can also perform the duties of fire extinguisher operator. Another person is required at the aircraft control panel to operate the control panel and the nozzle connection.

Emergency procedures are as follows:

1. The driver/operator shall immediately release the deadman control, and secure the PTO and emergency shut off valve to cut off the flow of fuel.

2. The driver/operator shall then remove the wheel chocks and man the fire extinguisher.

3. The fuel control panel operator shall disconnect the nozzle and bonding cable from the aircraft.

4. The fuel control panel operator shall then take over the fire extinguisher.

5. The driver/operator shall reel in the hose and move the truck or cart out of the area.

7.2.2 Procedures

All CG Air Stations shall have written instructions on cold refueling. As a minimum, instructions shall include the following procedures:

1. Recirculate the station or truck through the hose nozzle and take appropriate samples for quality control checks.

2. Check aircraft for hot brake condition (fixed wing only).

3. Tow or taxi aircraft into the refueling area. Aircraft shall not be cold refueled in the same refueling pit at the same time hot fueling is in progress. If an aircraft is towed into the fueling pit and the tractor remains attached, the tractor engine must be secured during fueling. If aircraft are being fueled from a truck, the truck engine may remain running if it is the only source of power for the pump. Otherwise, only the pump engine should be running.

4. Chock the truck wheels.

5. During the fueling operations, secure all aircraft electronics and electrical switches not required for normal operations.

6. There shall be no smoking, open flames, spark or flame producing items, or radio transmissions items within 50 feet of a cold refueling operation.

WARNING: Do not start cold refueling operations when a lightning advisory has been issued, indicating an electrical storm is within five miles of the Air Station.

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7. Verify that the required firefighting equipment is in the refueling area or pit. There should be a minimum of one 150# dry chemical fire extinguisher or a Twin Agent Unit (TAU) in the area and available for use.

WARNING: Aircraft radar and HF radios shall not be operated in the transmit mode within 300 feet of cold refueling operations.

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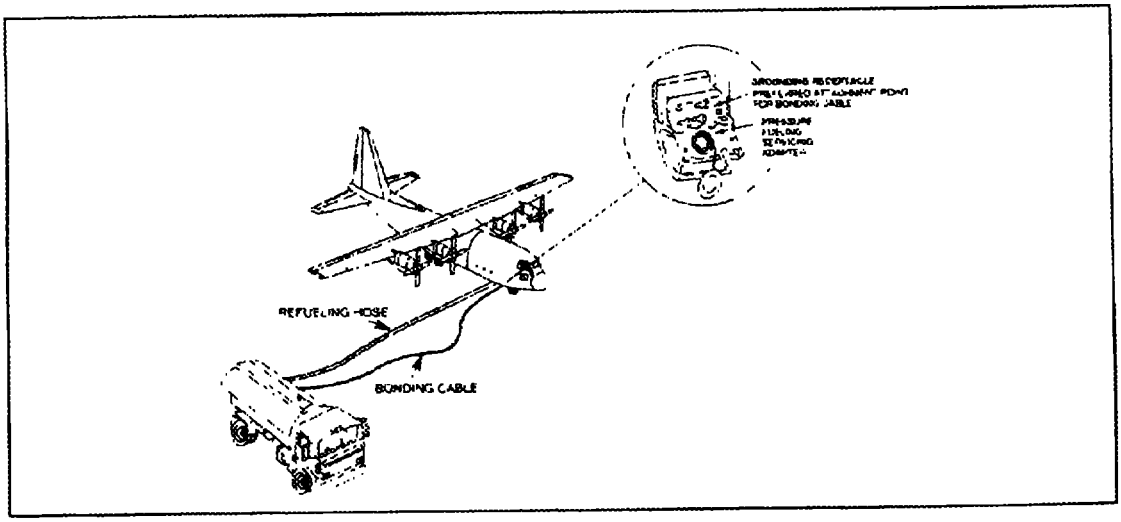
8. Shut down all operating equipment within 50 ft. that is not required for refueling and do not start up the equipment again until after fuel vapors have dissipated. There shall be no oxygen system servicing during cold refueling operations.

9. Equip all internal combustion engines operating within 50 ft. of cold refueling operations with a spark-arresting muffler. No aircraft or auxiliary power unit (APU) engines shall be started or stopped within 50 ft. during cold refueling operations.

Figure 7-1. Electrical Bonding of an Aircraft and a Truck



10. Attach bonding cable between the aircraft and the refueling station or refueler. Figures 7-1 and 7-2 show typical bonding connections between an aircraft and a truck or direct fueling station, respectively.

11. Pull out the hose and place in proper position for refueling.

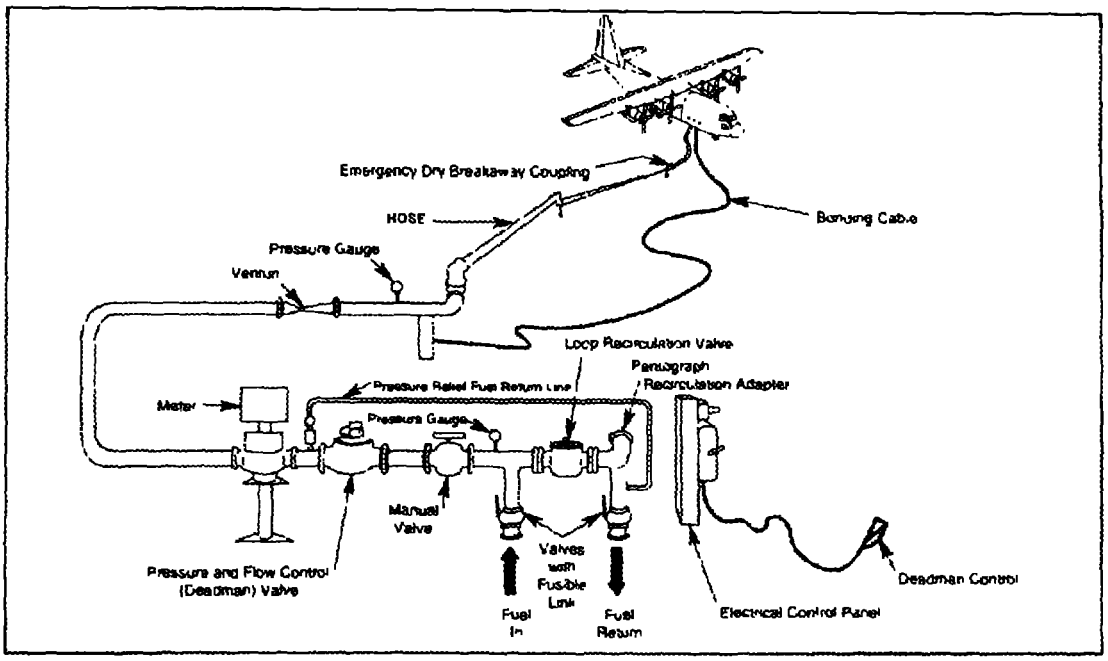
12. Remove the fueling cap from aircraft and the dust cover from the single point nozzle. Inspect the face of the nozzle to ensure it is clean and verify that the flow control handle is in the fully closed position. Nozzle will not connect if handle not fully closed.

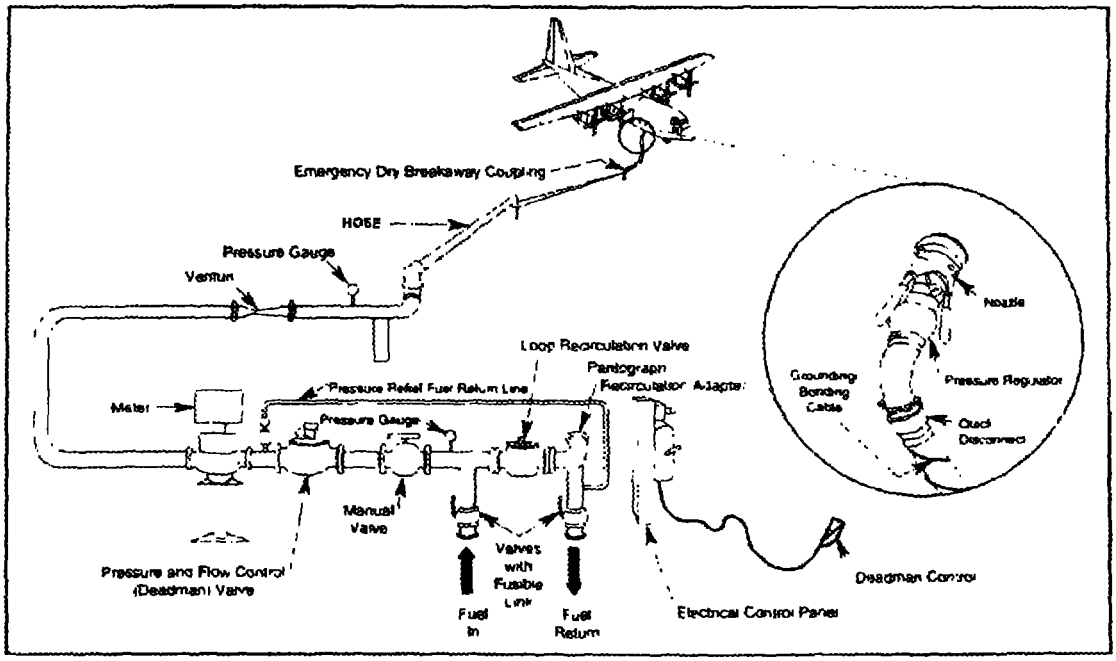
13. Visually inspect the aircraft's adapter or receptacle for damage or wear. If there is any doubt about the integrity of the adapter, do not re-fuel.

14. Lift the nozzle by the lifting handles, align the lugs with the slots on the aircraft adapter, and hook up to the aircraft by pressing it firmly into the adapter and rotating clockwise to a positive stop. The nozzle must be seated firmly on the receptacle and not be cocked, before opening the single-point, nozzle handle. Zero the refueling station or truck meter.

15. Open valves on truck and actuate the remote, hand-held, deadman control, upon receiving signals from the nozzle/operator and fueling supervisor that hook up has been completed and the fueling operation is ready to begin.

Figure 7-2. Bonding of Aircraft to Direct Refueling Station





16. Rotate the nozzle flow control handle to the FULL OPEN position. When the hose is fully charged, the handle shall be rotated through 180 degrees to ensure the poppet valve is fully open and locked.

CAUTION: The pre-check system simulates the completion of a fueling evolution. All fuel flow into the aircraft shall stop within one minute of the system being activated for refuelers equipped with a Scully System. The refueling station meter will stop registering fuel flow if the pre-check system is working properly. Aircraft should not be refueled if the pre-check system test fails, unless an emergency exists.

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17. Exercise the aircraft pre-check system once fuel flow has been established.

18. Fuel aircraft as directed by the fueling supervisor. The fueling supervisor shall monitor aircraft vents, tank pressure gauges, warning lights, and/or fuel panels.

19. Release the deadman control when directed by the fueling supervisor or by the refueling panel.

20. Rotate the nozzle flow control handle into the OFF and fully locked position.

21. Disconnect the nozzle from the aircraft.

22. Stow the hose. Close all valves on refueler. Remove wheel chocks.

23. Read meter and record. Complete paperwork.

7.2.3 Truck Preparation

If a truck is used to refuel the aircraft, these additional procedures are needed for truck preparation:

1. Re-circulate the fuel through the hose and nozzle and take appropriate samples.

2. Drive the truck into position following the path described in paragraph 7.9 of this Manual. The truck shall be positioned so that it can be driven away quickly.

3. Set the brakes and ensure wheel chocks are used.

4. Place the gearshift in neutral.

5. Turn off the headlights and any unnecessary switches.

6. Open the driver's side door and leave open during refueling.

7.3 OVERWING REFUELING

All CG Air Stations shall have a written instruction for overwing refueling

7.3.1 Personnel Requirements

Overwing refueling procedures by hydrant, refueler (cart), or truck, requires three people: an aircraft fuel control panel operator, a fuel system operator/truck driver, and a fire extinguisher operator.

7.3.2 Procedures

As a minimum, instructions shall include the following procedures:

1. Attach bonding cable between the aircraft and the refueling station or refueler. Figure 7-3 shows a typical bonding connection for overwing refueling.

2. Recirculate the refueler through the hose nozzle and take samples for quality control checks in accordance with paragraph 5.2.4 of this Manual. Chock the wheels on refueler vehicles.

3. Check for hot brakes.

4. Tow or taxi the aircraft into the refueling area. Aircraft shall not be cold refueled at the same refueling pit at the same time a hot refueling is in progress. If an aircraft is towed into the fueling pit and the tractor remains attached, the engine must be secured during fueling evolution.

5. Secure all non-essential aircraft electronics and electrical switches during refueling.

6. Verify that manned firefighting equipment is in the refueling area. There should be a minimum of one 40# dry chemical extinguisher or a TAU within 50 ft. and available for use.

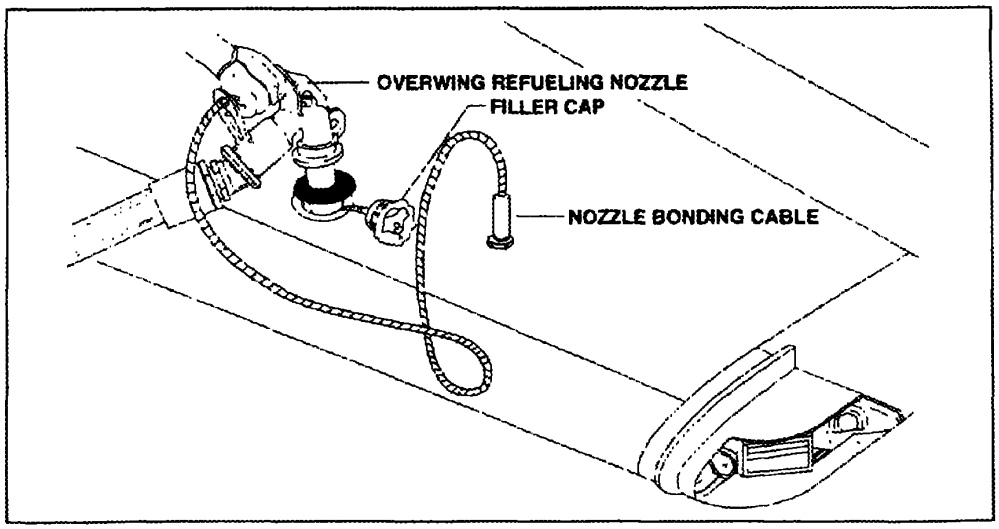
7. There shall be no smoking, open flames, spark or flame producing items, or radio transmissions items within 50 feet of an overwing refueling operation.

8. Do not transmit on HF radios within 300 ft. of an overwing refueling operation. Place radars in the stand-by mode (no transmission).

9. Shut down all operating equipment in the area not required for refueling. Do not start up again until after fuel vapors have dissipated.

CAUTION: Do not service oxygen systems during overwing refueling operations.

Figure 7-3. Electrical Bonding of Overwing Refueling Nozzle to Aircraft



10. Equip all internal combustion engines operating within 50 ft. of overwing refueling operations with a spark-arresting muffler. Do not start or stop aircraft engines or auxiliary power unit (APU) engines during overwing refueling operations if they are located in the refueling area.

WARNING: Do not start refueling operations when a lightning advisory has been issued, indicating an electrical storm is within five miles of the Air Station.

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11. Zero the refueling station or trucks meter.

12. Pull out the hose and place in proper position for refueling.

13. Bond the overwing nozzle to the aircraft.

14. Insert the overwing nozzle into the aircraft refueling port and maintain a metal-to-metal contact throughout the fueling evolution.

15. The station operator may actuate the remote, hand held, deadman control, upon receiving signals from the nozzle/operator and fueling supervisor that hook up has been completed and fueling operation is ready to begin.

16. At the refueling supervisor's direction, the nozzle operator shall initiate fuel flow by squeezing the handle on the overwing fueling nozzle.

17. The fueling supervisor shall monitor aircraft vents, tank pressure gauges, and warning lights.

18. Release the deadman control when directed by the fueling supervisor or safety observer.

19. Disconnect the nozzle bonding wire and refueler/truck bonding wire from the aircraft. Remove wheel chocks.

20. Stow the pantograph or hose reel.

21. Read the meter and record. Complete the paperwork.

7.3.3 Truck Preparations

Truck preparations for overwing are the same as for pressure refueling, except that the overwing nozzle is used. (See paragraph 7.1.2 of this Manual.)

7.4 HOT REFUELING

WARNING: Hot refueling aircraft is a hazardous operation and should never be regarded lightly. An analysis of historical USAF, USN, and USCG hot refueling incidents has revealed trends that all Engineering Officers, Safety Officers, command staff, and aviation personnel should be cognizant of. Nearly all Class A, B, and C hot refueling mishaps involve failure of one or more of the following:

The SPR nozzle locking device.
Failure of the SPR nozzle operator to properly engage the locking mechanism.
Failure of the hose.
Failure of hose couplings.
Failure of aircraft internal fuel transfer plumbing or valves.

Hot refueling at night is particularly hazardous, and should be executed with utmost caution. Night hot refueling shall be performed in well-lighted areas only. The use of night vision devices while hot refueling is prohibited.

Overwing hot refueling is prohibited except in emergencies. All CG Air Stations shall maintain written instructions on hot refueling. The Logistics Compliance Teams shall review the hot refueling instructions. As a minimum, the instructions shall include the following procedures and requirements.

7.4.1 Personnel Requirements

Hot refueling procedures require a minimum of four people; one in the truck, one on fire guard, one fuel system operator on the dead man control and one person operating the aircraft fuel control panel.
Note: The fuel truck driver may also serve as the dead man control operator.

7.4.2 Procedures Prior to Entering the Refueling Area

Units shall perform the following before the aircraft enters the hot refueling area:

1. Notify the local fire department at least 15 minutes before hot refueling.

2. Check for hot brakes on aircraft.

3. Recirculate the refueler through the nozzle and take fuel samples as appropriate before the aircraft arrives.

4. Check the area for FOD.

5. The hot refueling supervisor shall insure that the refueling team is properly outfitted with hearing protection, goggles, flight crew helmets, long-sleeved shirts, and appropriate pants. Footwear shall not have nails or metal plates capable of causing a spark.

CAUTION: Crew changes shall not be made in the fueling pit or designated hot refueling area during hot refueling operations.

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6. Qualified personnel shall ensure that all ordnance and pyrotechnics are safe.

7. There shall be no smoking, open flames, spark or flame producing items, or radio transmissions items within 50 feet of a hot refueling operation.

7.4.3 Procedures in the Hot Refueling Area

Once the aircraft is ready for entry into the hot refueling area, the following procedures shall be performed:

1. Taxi the aircraft into the designated hot refueling area in accordance with the local CG Air Station's operating procedures. The area shall be defined with a red circle drawn on the pavement. The aircraft shall enter the refueling area with the receptacle on the side of the aircraft nearest the hose. Once properly positioned, the aircraft shall be chocked. The aircraft may not be parked within 100 ft. of a building or another aircraft during hot refueling operations.

WARNING: The refueling hose must be extended to a sufficient length for the emergency dry breakaway device to work properly, without interfering with the movement of the aircraft.
The hose shall not pass under the aircraft to reach the SPR connection.
Discontinue refueling immediately if leaks are discovered.
The deadman control operator shall have a direct line-of-sight to the refueling operator at the aircraft receptacle.
If either the primary or secondary shut-off valve test fails, the hot refueling operation shall be halted immediately.
Aircraft doors/windows, located on the same side as the SPR, shall remain closed during the hot refueling operation.

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2. The qualified aircrew shall secure all unnecessary electronic and electrical equipment not needed for refueling.

CAUTION: Aircraft radars and HF radios shall not be operated in the transmit mode within 300 feet of hot refueling operations. All internal combustion engines operating within 50 feet of a hot refueling procedure must be equipped with a spark-arresting muffler.
No internal combustion engine shall be started or stopped within 50 ft. of the hot refueling area.

WARNING: Do not start hot refueling operations when a lightning advisory has been issued, indicating an electrical storm is within five miles of the Air Station.

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3. Verify that firefighting equipment is attended and properly positioned in the hot refueling area. (See paragraph 7.4.4, item 5, of this Manual.)
4. There shall be no smoking, open flames, spark or flame producing items, or radio transmissions items within 50 feet of an overwing refueling operation.
5. Bond the aircraft to the refueling equipment. Chock refueler vehicle wheels.
6. Pull out the hose or pantograph and place in the proper position for refueling.
7. Remove the fueling cap from aircraft and the dust cover from the SPR nozzle. Inspect the face of the nozzle to ensure it is clean and verify that the flow control handle is in the fully closed position.
8. Visually inspect the aircraft's adapter or receptacle for damage or wear. If any doubt exists about the integrity of the adapter, do not proceed with fueling operations.
9. Lift the nozzle handles, align the lugs with the slots on the aircraft adapter, and hook up the nozzle to the aircraft by pressing it firmly into the adapter and rotating clockwise to a positive stop. The nozzle must seat firmly on the receptacle and not be cocked.
10. Zero the refueling meter.
11. The station operator/truck driver shall open all valves on the truck and engage the dead-man control after receiving a signal from the nozzle operator/fueling supervisor that the hook-up has been made.
12. Rotate the nozzle flow control 180 degrees to the full open position when the hose is fully charged. Do not attempt to use the nozzle flow control to regulate fuel flow.

CAUTION: The pre-check system simulates the completion of a fueling evolution. All fuel flow into the aircraft shall stop within one minute of the system being activated. The refueling station meter will stop registering fuel flow if the pre-check system is working properly. Aircraft should not be refueled if the pre-check system test fails unless an emergency exists.

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13. Once fuel is flowing, exercise the precheck system of the aircraft.

14. Fuel the aircraft as directed by the fueling supervisor. The fueling supervisor shall monitor vents, tank pressure gauges, and any warning lights.

15. Release the deadman control when directed by the plane captain.

16. Rotate the nozzle flow control handle into the OFF and fully locked position.

17. Disconnect the nozzle and bonding wire from the aircraft.

18. Stow the hose and nozzle. Remove wheel chocks from aircraft and refueler vehicle.

19. Ensure the area is clear of equipment and personnel.

20. Taxi the aircraft away from the area.

21. Notify the local fire department that hot refueling is completed.

22. Complete the paperwork.

7.4.4 Equipment Requirements

The following equipment is required to conduct a hot refueling:

Fuel hydrant, mobile refueler (cart) or refueler truck. The refueling system must be grounded through a connection that offers less than 10,000 ohms of resistance. The fuel system shall also have a fully functioning deadman control.
A refueling hose, fuel truck or refueler cart.
One bonding cable.
Aircraft wheel chocks.
Either of the following:
two 150# Dry Chemical extinguishers,
two 150# HALON extinguishers (use only until expended; do not purchase replacements; purchase dry chemical instead),
one Twin Agent Unit (TAU) extinguisher,
or an aircraft crash rescue/fire-fighting vehicle is required.

If the emergency vehicle is called away during the hot refueling, the fueling must stop and may not proceed until the fire/rescue vehicle returns. If 150# Dry Chemical Units or HALON units are used, at least one must be manned and ready just outside the 50 ft. Fuel Servicing Safety Zone. The other unit shall be immediately available within 100 feet of the FSSZ.

One emergency dry-breakaway coupling

7.5 DEFUELING OPERATIONS

Defueling operations are technically more demanding and potentially more dangerous than regular fueling operations. Most aircraft defueling pumps and equipment can defuel an aircraft faster than the aircraft can release it. This can damage the aircraft fuel system. The defueling pump must normally be regulated to prevent cavitation that could damage the pump. Once the proper balance is achieved, it must be maintained by manipulating the valve on the downstream side of the pump.

Defuelings normally have a lower priority than a refueling, however a defueling request due to a fuel leak or maintenance shall be given the highest priority consistent with current operations.

All CG Air Stations shall have written instructions on defueling. As a minimum, instructions shall include the following procedures:

Maintenance not connected to the defueling operation is prohibited.

Aircraft shall not be positioned any closer than 50 feet from another aircraft or building.

Any vehicles operated within 50 feet of the fueling area shall be equipped with spark arrestors.

Eductor/evacuation systems shall not be used to defuel aircraft.

Suspect aviation turbine fuel shall be removed by a defueler only and deposited in a designated storage area.

The aircraft and the defueler unit must be bonded to each other during the entire operation.

There shall be no defueling within 300 feet of operating ground or aircraft radar.

There shall be no smoking, open flames, spark or flame producing items, or radio transmissions items within 50 feet of a defueling operation.

All operating equipment in the fueling area must be shut down before starting defueling and not started up again until the process is complete.

A minimum of one, 150# dry chemical fire or TAU extinguisher, shall be readily available in the defueling area.

Routine defueling for weight and balance, fuel load change, or maintenance does not require special handling or sampling.

Fuel containing leak detection dye can be reissued to aircraft.

The Aviation Engineer Officer or qualified personnel shall decide on the disposition of all defueled turbine fuel.

The defueling unit shall maintain a flooded suction above the anti-vortex splash plate in its tank to minimize turbulence and possible ingestion of air. Normally this involves keeping a minimum of 1,000 gallons in the defueling unit. Equipment may differ and minimum standards may need to be set for each defueler at an Air Station.

Valves that control the flow of fuel from the tank to the upstream side of the pump shall remain closed during defueling to prevent recirculation in the tank.
Defueling will be discontinued if the pump starts to cavitate or lose prime. Operations shall not be restarted until the cause has been found and fixed.
Defueler tank tops shall not be opened during defueling.
All defueling operations shall be noted in a separate logbook.

The log must record as a minimum:

Reason for defueling.
Date and time.
Aircraft tail number.
Amount and type of fuel removed.
Disposition of removed fuel.
Name of personnel that performed the defueling operation.

7.5.1 Personnel Requirements

Cold defueling an aircraft to a hydrant, refueler (cart), or truck requires three people:

one fuel system operator/truck driver performing the duties of fire extinguisher operator,
one person operating the aircraft control panel, and
one person monitoring the fuel level in the truck or refueler vehicle.

Emergency procedures are as follows:

1. The driver/operator shall immediately release the deadman control and secure the PTO to cut off the flow of fuel.

2. The driver/operator shall stand-by the fire extinguisher.

3. The fuel control panel operator shall disconnect the nozzle and bonding wire from the aircraft and secure the controls.

4. The fuel control panel operator shall take over the fire extinguisher and remove the chocks.

5. The driver/operator shall reel in the hose and move the truck or cart out of the area.

7.5.2 Defueling Procedures

Aircraft defueling procedures are as follows:

1. Sample the fuel to be removed, and inspect for clear and bright.

2. Determine the status of the fuel.

3. Determine the amount and type of fuel to be removed.

4. Select defueling equipment to be used. Defueler for suspect fuel, or refueler/defueler for non-suspect fuel.

5. Position the defueler, if mobile. Chock the defueler vehicle wheels.

WARNING: Do not start defueling operations when a lightning advisory has been issued, indicating an electrical storm is within five miles of the Air Station.

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6. Verify that the aircraft is spotted properly.

7. Check for possible sources of ignition within 50 feet.

8. Connect the bonding wire from defueler to aircraft. Grounding of either the refueler or the aircraft is not required.

9. Position and connect the defueling hose to the aircraft and the defueling stub on the defueler.

10. Commence defueling when signaled by the nozzle operator.

11. Adjust the valve downstream of the pump for optimum flow rate. Frequently, this is pre-set on defueling equipment.

12. Secure all equipment when defueling operations are complete.

7.5.3 Disposition of Removed Fuels

Suspect aviation fuel shall be removed from the aircraft using a defueler only and deposited in a designated holding tank. Ultimate disposition will depend on the results of lab tests. A special log of each defueling operation shall be maintained. Fuel not suspect of being contaminated can be defueled and used to fuel any aircraft. Fuel shall be tested for Clear & Bright and FlashPoint before being returned to a storage tank.

7.6 CONCURRENT FUELING

The Aviation Engineer Officer may authorize concurrent fueling evolutions when operations require it. All CG air Stations shall have a written instruction covering local procedures for concurrent fueling operations. Loading of ordnance or pyrotechnics shall never be authorized during fueling operations.

NOTE: Concurrent fueling operations are defined as fueling while conducting maintenance or loading/unloading stores, equipment or personnel.

7.6.1 Personnel Requirements

Concurrent refueling of aircraft from a hydrant, refueler (cart), or truck requires two people. One fuel system operator or truck driver who can also perform the duties of fire extinguisher operator and one person operating the aircraft control panel to monitor the fuel control panel and the nozzle connection. These two individuals will always be exclusive of all other personnel performing concurrent tasks.

In the case of an emergency, the driver/fuel system operator shall immediately release the deadman control and secure the PTO to cut off the flow of fuel. He shall then remove the wheel chocks and man the fire extinguisher while the fuel control panel operator disconnects the nozzle from the aircraft. The fuel control panel operator shall then take over the fire extinguisher while the driver/operator reels in the hose and moves the truck or cart out of the area.

7.6.2 Procedures

As a minimum, the following procedures and precautions shall be included in the Air Station instruction on concurrent fueling.

1. Equip all engines operated within 50 feet of concurrent refueling operations with spark arresting type mufflers.

CAUTION: No engines shall be started or stopped within 50 feet of a concurrent refueling operation.
A 150# dry chemical extinguisher or TAU shall be located in the fueling area.

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2. Any vehicle connected to the aircraft shall also be bonded to the aircraft. This includes fuel pipelines, refueler vehicles (carts), and trucks.

WARNING: Do not start concurrent refueling operations when a lightning advisory has been issued, indicating an electrical storm is within five miles of the Air Station.

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3. Do not operate aircraft radar and H/F radios in the transmit mode within 300 feet of concurrent refueling operations.

4. There shall be no smoking, open flames, spark or flame producing items, or radio transmissions items within 50 feet of an overwing refueling operation.

5. Position a crash/rescue vehicle just outside the fueling area if passengers or Medevac patients will remain on board the aircraft during the fueling operation.

6. Provide unobstructed ramps for quick egress when passengers or patients are on board during refueling.

CAUTION: Passengers and Medevac patients shall not board or leave the aircraft while fueling is in progress, unless an emergency exists. Aircraft maintenance repair work or oxygen system servicing shall not be permitted during fueling operations

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7. Maintain a communications system to link the person in charge of the fueling operation with the crash/rescue truck.

8. Maintain a clear path around the aircraft at all times.

7.7 FUEL ISSUE CONTROL SYSTEM

Where more than one grade of fuel is stored, the issue of fuel to aircraft refuelers shall be controlled to ensure the proper grade of fuel is

transferred. The use of different size couplers for each grade where bottom loading is used is an acceptable method. If only one grade of product is handled, a fuel issue control system is not required.

7.8 POSITIONING EQUIPMENT

These procedures shall be duplicated each time there is refueling so all personnel involved will know what to do. Whenever possible, refuelers shall proceed down a line perpendicular to the aircraft fuselage access. The refueler shall stay at a distance equal to the length of the hose. At no time shall a refueler proceed closer than ten feet to an aircraft. Driving between parked aircraft in a line shall be avoided.

WARNING: Refuelers shall NEVER:
Be parked pointing towards any part of the aircraft.
Be driven closer than 10 feet from any point on the aircraft.
Be left less than 25 feet from a fueling port or vent.
Be backed near an aircraft.

The following rules shall apply for positioning equipment:

The refueler shall be parked in a position on the same side of the aircraft as the aircraft's adapter so that the driver/operator has a direct line of sight to the refueling nozzle operator while actuating the deadman control.

WARNING:
Failure of the driver/operator to observe the nozzle operator can lead to a serious fuel spill and fire.
The hose shall not pass underneath the aircraft.
Never conduct concurrent overwing and pressure fueling operations.

Tailpipe temperature and the location of aircraft tank vents are important considerations when positioning refueler equipment. Refuelers must be positioned inside a fueling pit with a contained drainage system during all fueling operations. Refuelers shall not be parked closer than 50 feet from any structure during fueling operations.

Figures 7-4 and 7-5 show the correct ways for refueler trucks to approach a fixed wing aircraft and a helicopter, respectively.

7.9 BONDING AND GROUNDING

Prior to making any fueling connection to an aircraft, the fueling equipment shall be bonded to the aircraft with a metal cable, providing a conductive path to equalize potential between the fueling equipment and the aircraft. The bond shall be maintained until fueling connections have been removed. This allows separated charges that could have been generated during the fueling operation to be reunited.

The following rules shall apply for bonding:

Bonding Clamp. When the aircraft being serviced is not equipped with grounding receptacles, a clamp shall be used on the bonding cables of refueling equipment. The clamp shall conform to MIL-C-83413/7B. When a clamp is used, it shall be connected to a bare metal surface of the aircraft.

Overwing Nozzle Bonding. In addition to the above, when fueling overwing, the nozzle bond cable shall be connected to a metallic component of the aircraft that is connected metallically to the tank filler port. The bond connection shall be made before the filler cap is removed, and shall remain connected until the servicing is complete and the filler cap replaced.

Bonding Plug. When the aircraft being serviced is equipped with grounding receptacles, a plug shall be used on the bonding cables of refueling equipment. The plug shall conform to MIL-C-83413/4A.

CAUTION: Any petroleum fuel moving through a handling system to storage tanks, tank cars, refueling units, or aircraft tanks will develop a static electrical charge, and will carry this charge into the container. This charge will be present although the system and equipment being used are properly grounded and bonded.

Figure 7-4. Refueler Approach to Fixed Wing Aircraft

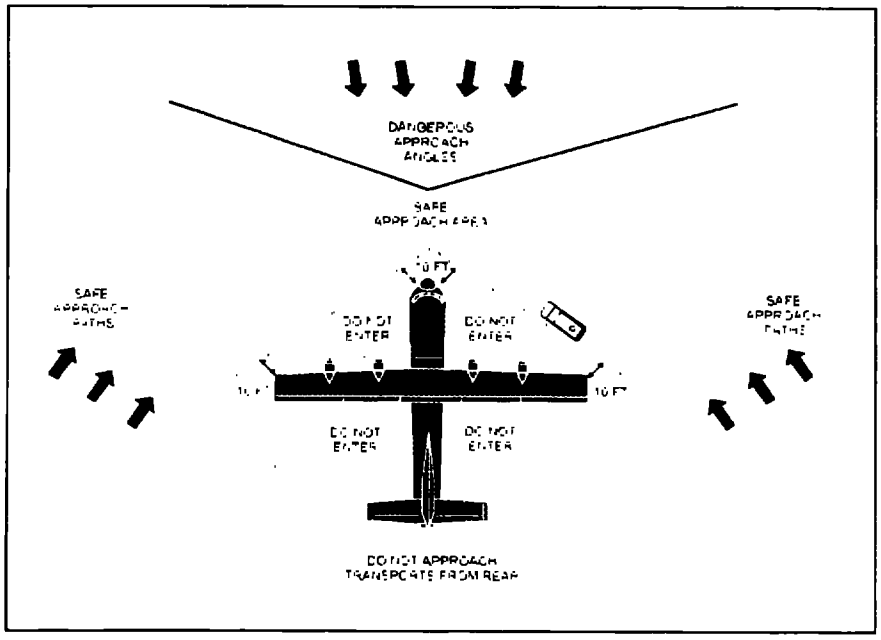
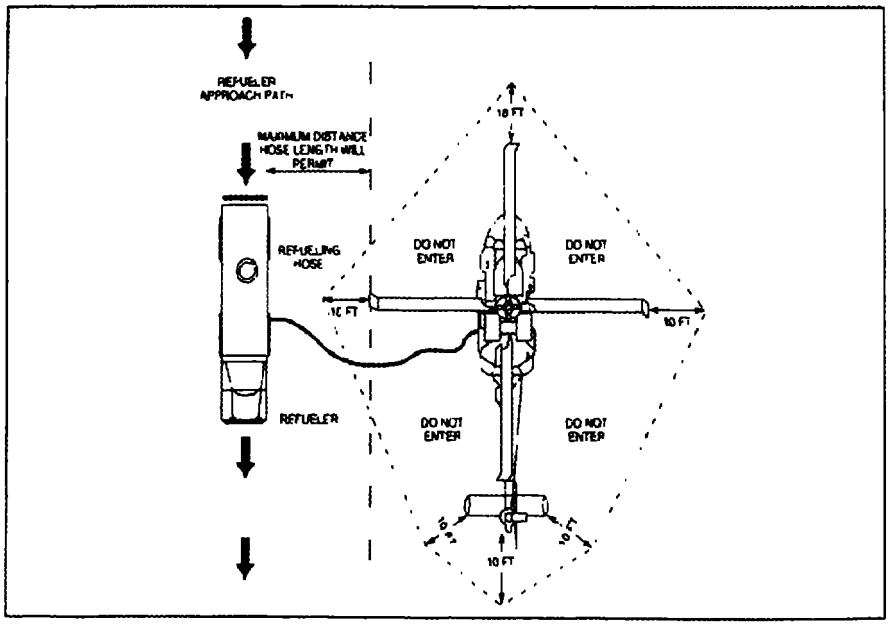


Figure 7-5. Refueler Approach to Helicopter



When two different materials come into contact, electrical charges flow across the surfaces of contact. This occurs when petroleum fuels flow through pipes, valves, pumps, and filter/separators. The continuous contact and separation process when fuel flows through a bulk handling system results in the gradual buildup of a charge in the fuel and of an opposite charge in the pipeline. The charge in a properly grounded pipeline will leak away rather rapidly but the charge in the fuel will tend to be carried downstream. The charge buildup in the fuel does not continue indefinitely. If the piping system is long enough, the rates of accumulation and dissipation of charge in the fuel will reach equilibrium, and the charge per gallon of fuel moving downstream will remain constant. However, the equilibrium charge for a given pipe and fuel will increase with an increase in the velocity of the fuel.

The hazard of static charges is particularly acute in pumping JP-4 into a tank because the atmosphere (vapor-air mixture) in which the spark occurs is likely to be within the flammable or explosive range. Since avoiding or eliminating the vapor space or the flammable vapor-air mixtures in tanks is virtually impossible, the only effective way of reducing the hazard is to minimize the buildup of the static charge.

7.10 FUEL EQUIPMENT/VEHICLE SAFETY

The following safety precautions for refueling vehicles and equipment shall be observed to ensure the safe and proper fuel servicing of aircraft:

Fuel truck operators shall have a valid state truck driver's license if they drive over public roads. A military driver's license is required if they drive on DOD installations. Fuel truck operators shall ensure there are no fuel leaks and the general condition of the refueler is satisfactory.

Fuel servicing vehicles shall not be used if any safety equipment is not in proper working order. Safety devices shall not be bypassed in the interest of "getting the job done."

Fuel servicing vehicles shall approach the aircraft so the operator's side of the vehicle is adjacent to the aircraft. Fuel servicing vehicles shall be operated in a safe and professional manner at all times. The maximum ramp speed shall be five miles per hour.

All fuel service vehicles shall carry a spill kit. Fuel servicing equipment shall not proceed closer than 20 feet from the aircraft without guidance from ground personnel to ensure proper clearances.

A distance of 25 feet shall be maintained between the refueling vehicle and the aircraft filler points and vents. Whenever possible, fuel servicing vehicles shall be parked upwind from the aircraft fuel tank vents during refueling operations.

A minimum of 10 feet shall be maintained between the refueling vehicle and any portion of the aircraft.

All operating equipment not required in the fuel servicing operation shall be shut down before the start of the operation. The equipment shall not be restarted until fuel vapors have dissipated.

A portable 150# dry chemical or TAU fire extinguisher shall be the minimum for refueling operations. It will be placed in the immediate vicinity of the refuel/defuel operation and be positioned for immediate use.

Under no circumstances shall the fuel truck operator drive or operate any fuel servicing equipment in the servicing area if fuel is leaking from the aircraft or a major fuel spill is detected near the aircraft.

If a fuel spill should occur during fueling operations, immediately stop all fuel servicing, and comply with the procedures outlined in paragraph 9.1 of this Manual.

All internal combustion engines operated within 50 feet of fueling operations must be equipped with a spark arrestor.

Refueling operations are not to be carried out at the same time as oxygen system servicing.

7.10.1 Procedures

CG Air Stations using trucks to refuel aircraft shall follow the following procedures.

7.10.1.1 Filling the Truck

Loading the truck is a two-person operation even for trucks equipped with high level alarms/shut-off and dead man controls at the fill stand. Top loading a truck with fuel is not authorized unless there is no other means of filling the truck. Personnel shall avoid standing on top of the truck during the fueling operation where practical.

All refueler trucks shall be refueled as follows:

1. Position the truck, turn off lights, place gear shifter in neutral or park, set parking brake, stop engine and turn off all unnecessary equipment.
2. Verify the grade of product and amount to be loaded.
3. Chock the refueler vehicle wheels.
4. Connect the bonding wire. Figure 7-6 shows a typical bonding connection between a truck and a truck fill stand.
5. Connect the delivery nozzle to the truck's bottom loader.
6. Set the meter to zero and fill out any required paperwork.
7. Start fueling the truck slowly.
8. After the tank is filled, secure the pump if it does not automatically secure.
9. Disconnect the nozzle.
10. Disconnect the bonding wire.

11. Check for leaks.

12. Remove wheel chocks

13. Move the refueler to the truck parking area.

14. Complete the paperwork.

7.10.1.2 Refueler Parking

CG Air Stations shall require that all refueler trucks be attended when the engine is running. Operator is considered in attendance when performing functions related with refueling aircraft. When parking the truck for the night or otherwise leaving it unattended, the driver/operator shall follow these procedures:

1. Drive the truck clear of the aircraft.

2. Set the parking brakes.

3. Direct the front wheels to an open unobstructed area.

4. Stop the engines.

5. Chock the wheels.

6. Ground the truck.

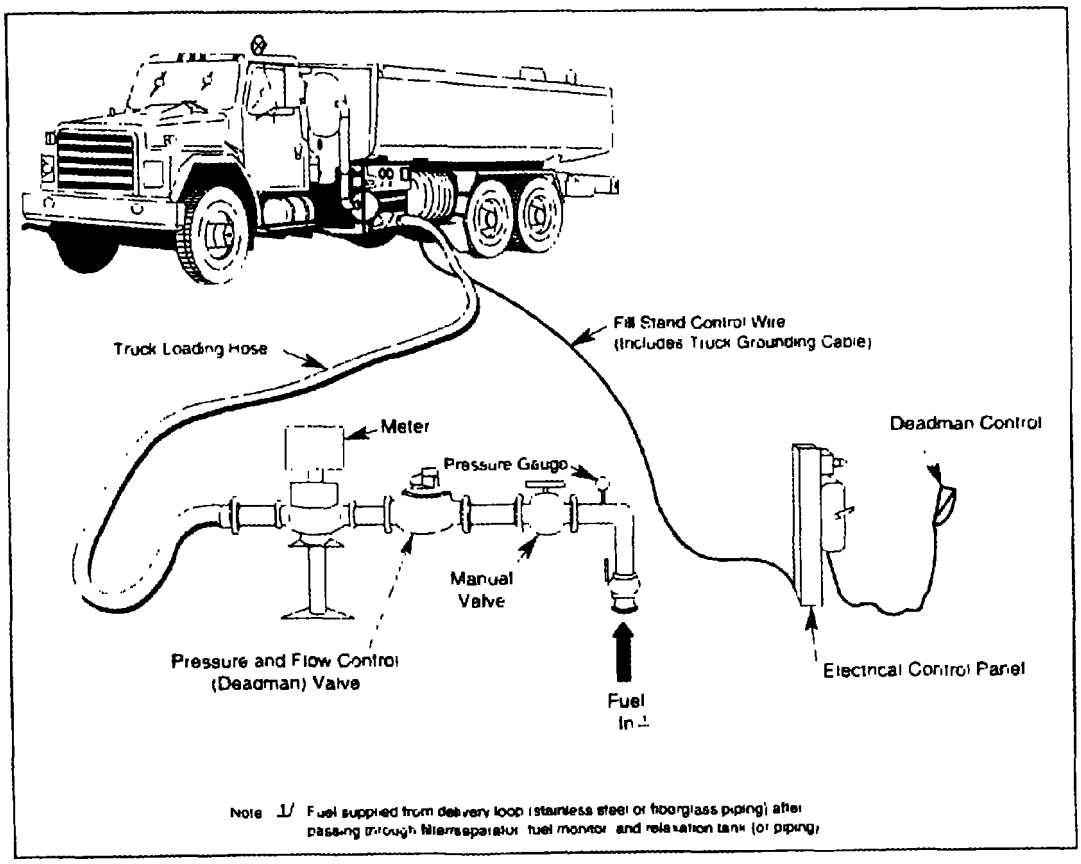
7.10.2 Refueler Parking Area Requirements

Park in a designated parking area by the airport or CG Station. CG Air Stations with refueler trucks shall have an adequate dedicated refueler truck parking area. Both the parking area and the roads the refueler truck travels on shall be paved. If avoidable, refueler trucks are NEVER to be driven over grass, dirt, or other soft surfaces. Parking areas shall be free of potholes, ruts, and FOD.

Parking area requirements are as follows:

A minimum lateral separation of 25 feet between trucks.
No trucks to be parked closer than 100 feet from any building.

Figure 7-6. Truck Fill Stand



Separate entry and exit gates to facilitate one-way traffic entering and leaving the parking area.

Free and direct egress of any truck from the parking area at any time. No backing, jack-knifing or additional maneuvering shall be required.

A security fence to prohibit unauthorized entry.

Security lighting capable of illuminating the entire refueler parking area.

Spill containment system that drains to an oil water separator. The parking area should be concrete. Asphalt tends to allow fuel spills to penetrate the roadway; concrete will allow it to drain off properly.

8. SAFETY COMPLIANCE

This chapter describes safety procedures and requirements that are either general in nature and have not been covered in other chapters of this Manual, or which are extremely important and *are repeated here for emphasis*. These safety procedures and requirements **are no substitute for a thorough knowledge of aviation fuels and their inherent characteristics and dangers.** All CG personnel shall handle aviation fuels with the maximum caution because of the obvious dangers associated with possible fires, explosions, and hazard to humans.

Although kerosene type fuel such as JP-5 is much less volatile than JP-4, under certain conditions, such as severe agitation, mists that are extremely flammable and explosive can form. This makes breathing very hazardous. Personnel should wear a filter mask or stand 50 feet away from vapors. Handle all aviation fuels with care.

CAUTION: All personnel involved in aircraft fueling evolutions shall wear protective clothing/equipment (gloves, aprons, or eye protection) approved for the materials and equipment being used. Contact your supervisor or safety officer for guidance and read paragraph 8.3 of this Manual.

8.1 MINIMIZING HEALTH HAZARDS

In order to minimize health dangers fuel-handling personnel shall:

1. Whenever possible, avoid entering enclosed areas where fuel vapors may be present.

2. Always minimize the exposure to fuel vapors. Good ventilation of workspace is essential.

3. Stay on the upwind side of a fuel spill if it is necessary to remain in an area where a large spill has occurred.

4. Stay on the upwind side of a fuel spill occurring during fuel handling operations, where the formation of vapors is unavoidable, such as at a truck fill stand.

5. Stop the fuel handling operation and move to a fresh air location immediately if dizziness or nausea occurs.

6. Avoid skin contact with fuels that can contain FSII. If fuel does contact the skin, immediately wash with soap and water.

7. Never wash hands in gasoline or jet engine fuels.

8. Do not allow fuel to dry on skin or clothing. Remove fuel-soaked clothing and wash skin areas with soap and water. Do not wear fuel-soaked clothing in shop spaces.

9. Wear eye protection and clothing that leaves a minimum amount of skin exposed during refueling operations. In case of a fire, appropriate protection will minimize burns.

8.2 SMOKING/OPEN FLAMES

Prohibit smoking, open flames, and sources of ignition within 50 feet of fueling operations. The fuel farm containment area, the refueler parking area and the cab of the refueler truck shall also be designated "No Smoking" areas at all times. Internal combustion engines shall not be operated within 50 feet of refueling operations unless equipped with an approved spark arrestor. Internal combustion engines shall not be started or stopped within 50 feet of a fueling operation.

8.3 PROTECTIVE EQUIPMENT

To protect themselves:

Fueling operations personnel shall wear eye protection and clothing that expose as little skin as possible. They shall not carry or wear:

- Loose metal objects.
- Knives.
- Keys.
- Objects that might fall into a tank.
- 100% nylon outer garments.

Fueling personnel shall not remove or put on clothing during fueling operations.

Personnel taking and testing fuel samples shall wear non-absorbent gloves.

Personnel performing fuel tests shall wear clear face shields and rubber or leather aprons.

Fueling crews shall only wear footgear that completely cover the feet to protect against fuel spills and fires. They shall not wear:

- Shoes made of fabric or other absorbent materials.
- Shoes with nails or other metal devices on the soles that could cause a spark.

8.4 UNNECESSARY PERSONNEL

Personnel not directly involved in the fueling operation, or a concurrent fueling evolution, shall remain clear of the fueling area. Personnel that are performing Professional Qualification Standards (PQS) or On-The-Job-Training (OJT) before becoming fully qualified for the fueling detail may work in the area when properly supervised.

8.5 EXPLOSIVE SAFETY

Reducing or controlling the release of fuel vapors can enhance explosive safety. All CG Air Stations shall take the following precautions:

1. Treat empty containers as though they still contain fuel; they may contain dangerous fuel vapors.

2. Do not conduct fueling operations inside the hangar or any confined space that was not designed as a refueling area. This does not prohibit taking fuel samples from tank bottoms or aircraft sumps.

3. Keep all fuel containers, tanks, and filter/separator vessels closed except when necessary to open for operations.

4. Avoid spilling fuel.

5. Take immediate action to clean up any fuel spills.

6. Properly dispose of oily waste or rags immediately after use.

7. Never drive or move a refueler that is leaking aviation turbine fuel.

8. Immediately report all leaks in the fuel handling facilities to the "Fuel King," Maintenance Control, the OOD and fire department.

9. Do not handle aviation fuel in open containers. Fuel vapors are heavier than air and will collect in low places such as pits, drains, and open sewers.

10. Never dispose of waste fuel in storm drains or sanitary sewage systems.

11. Never top load trucks or tanks.

12. Keep all equipment and work areas clean, neat, and in good working order. Ensure that all equipment is properly stowed after every evolution with caps and dust covers in place.

13. Never use aviation turbine fuel as a cleaning agent.

8.5.1 Tank Venting

Storage tank vents and filter/separator tank vents usually fall into the pressure/vacuum relief category. If properly maintained they will vent fuel or vapors whenever the pressure in the tank exceeds the setting for the vent valve. This means a tank could vent vapors at any time, though it is most likely to happen during a fueling evolution. Personnel should avoid being downwind of a fuel tank vent whenever possible and especially during a fueling evolution. Units shall never allow open flames or smoking within 50 feet of a tank vent.

8.6 BENZENE EXPOSURE

Most fuel oils contain benzene in some form. Repeated or prolonged exposure to benzene, even at relatively low concentrations, has been associated with various blood disorders ranging from anemia to leukemia. Fueling personnel should avoid breathing fuel vapors. If dizziness occurs, immediately move the victim into the fresh air, and obtain medical attention. The Occupational Safety and Health Administration (OSHA) has developed comprehensive benzene exposure standards (29 CFR, Subpart Z, Section 1910, 1028).

8.7 RF RADIATION HAZARDS

The aircraft's radios and radars shall not be operated in transmit mode during fueling operations.

Ground surveillance radar shall not be operated within 300 feet of a fueling operation.
Air surveillance radar shall not be operated within 300 feet of a fueling operation.
Radars and radios on an aircraft being fueled shall not be switched on or off during a fueling operation.

8.8 STATIC AND ELECTRICAL DISCHARGE PREVENTION

One of the primary sources of ignition in aviation fuel fires is static electricity. To minimize the risk posed by static electricity discharge, all CG Air Stations shall take the following precautions:

1. Prohibit the top loading of fuel trucks or tanks.
2. Refill filter/separator or monitor vessels slowly after they have been drained.
3. Keep tanks free of foreign objects. Thermometers or samplers may be suspended in a tank provided they are removed before receiving fuel.
4. Always electrically bond the aircraft to the refueling hydrant, mobile refueler (cart) or truck.
5. Check the resistance of Single Point Refueling (SPR) nozzles monthly.
6. Before removing tank caps, bond overwing refueling nozzles to the aircraft using a separate bonding pigtail.
7. Attach bonding cables to aircraft using plug and jack method wherever available.
8. Inspect bonding and grounding cables, clamps, and plugs daily.
9. Check the electrical resistance of cables monthly.
10. Prohibit fueling operations within five miles of an electrical storm.
11. Remove refuelers from aircraft parking areas during electrical storms.
12. Require fueling personnel to wear non-static producing clothing such as cotton.

8.9 BYPASSING FILTERS

Units shall bypass filters by switching to the stand-by filter whenever the differential pressure across the filter exceeds 15 pounds per square inch.

Incoming fuel may be received into a storage tank without passing through the service filter, provided the fuel received is isolated into a single tank and recirculated through the service filter prior to declaring it ready for issue. Units can only bypass the incoming service filters in urgent or emergent situations. Under no circumstances shall fuel be taken on directly into a service or day tank in this manner. The Aviation Engineer Officer, or designated representative, shall be notified of all instances of receipt of unfiltered fuel.

Units shall not dispense fuel into an aircraft, refueler truck, or hydrant without passing through the service filter at the fuel farm and/or on the refueler truck.

8.10 REFUELING MEDEVAC FLIGHTS

If refueling with non-ambulatory patients onboard, units shall position a crash/rescue truck just outside the fueling area. Only under the most urgent and compelling conditions should a unit or aircraft commander choose to forego the presence of a crash rescue vehicle while refueling with non-ambulatory patients onboard the aircraft.

8.11 WEATHER

Aircraft fueling operations are prohibited within five miles of electrical storms. Fueling operations should not be conducted in sustained winds of over 50 knots.

8.12 PERSONNEL GROUNDING/BONDING

Personnel will use grounding or bonding techniques to dissipate or equalize static charges that have accumulated during ground servicing operations.

During an aircraft fuel servicing operation, a static spark in the wrong place could ignite a fuel vapor concentration. Fuel service personnel will ground or bond themselves to a suitable grounding/bonding point before commencing the fueling operation. This can be done with a grounding stick or directly by hand.

If a spark occurs during the initial grounding or bonding procedure, atmospheric conditions are ideal for additional static charge accumulations. Under this condition personnel will ground or bond themselves periodically.

If no spark occurs during the initial grounding or bonding procedure additional grounding or bonding is not necessary.

All personnel will avoid grounding or bonding themselves within three feet of the aircraft fuel vent outlets.

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9. ENVIRONMENTAL ISSUES

Aircraft turbine fuel is highly toxic. It can damage the environment and endanger the health of humans and wildlife if handled improperly. Consistently following the safety procedures of this Manual will help to keep aviation fuel spills to a minimum and ensure contaminated fuels are disposed of safely. If/when fuel spills do occur, the fueling crew must take immediate steps to:

Limit the size of the spill.
Contain the spill.
Notify appropriate authorities i.e. OOD, Fire Department, HAZMAT Response Team, Maintenance Control.
Clean it up as quickly and safely as possible.

CG Air Stations shall develop a written instruction on fuel spill reaction that complies with current Commandant Instructions on HAZMAT handling and complies with local pollution laws. All CG Air Stations shall have a trained, designated "Spill Response Team" to handle "Large" fuel spills.

9.1 FUEL SPILLS

9.1.1 Small Spills

Small spills covering an area up to 18 inches in any dimension (small priming spills) are normally of minor consequence. Ramp personnel shall stand by until the aircraft is dispatched. Once the aircraft has left, the spill may be cleaned up with absorbent pads.

9.1.2 Medium Spills

Medium spills can cover 10 feet in dimension, but not over 50 square feet. They shall have a fireguard posted up wind equipped with at least one 150# dry chemical or TAU fire extinguisher. Absorbent cleaning agents (such as diatomaceous earth) or emulsion compound may be used to absorb the spilled fuel. Contaminated absorbent shall be placed in metal containers with closed lids until they can be disposed of in accordance with local hazardous waste disposal procedures.
An exception to this method may be authorized if the spill occurs in an area where no operations are in progress. In such an event, the area shall be roped off. Fuels such as JP-5 and JP-8 that will not evaporate shall be removed by absorption or emulsification.

9.1.3 Large Spills

Large spills over 50 square feet in area require handling by the "Spill Response Team." This is normally the airport or local fire department. The team shall be summoned immediately and all other personnel evacuated to a safe distance. No one shall be permitted to walk through the liquid area of a fuel spill.

NOTE: The above spill size designations are general. Local regulations may be more stringent.

9.2 LEAKING TANKS

In the event a fuel tank is found to be leaking, the following actions shall be taken as quickly as possible:

1. Empty the tank by pumping it into another tank(s). If none are available, summon empty refueler trucks and temporarily pump the tank contents into the refueler trucks.

2. Check the tank containment system and ensure that it is intact and no fuel is escaping the containment system. Place buckets or barrels under the leaking section if possible.

3. Call for the "Spill Response Team" if the spill meets the criteria of a Large Spill (see paragraph 9.1.2 of this Manual). If not, clean up the spill in accordance with the procedures for a "Small Spill" (see paragraph 9.1.1).

4. Attempt temporary repairs to the leaking pipes or tanks. Do not try to repair with "Hot Work" if the area has not been certified safe for hot work by an industrial chemist or gas-free engineer.

5. Ensure that the Aeronautical Engineer Officer and the Commanding Officer are notified immediately.

9.3 TANK CLEANING RESIDUE (SLUDGE)

Sludge (solid waste) removed during a tank cleaning shall be sealed in metal containers with closed lids and then disposed of, in accordance with the Coast Guard Hazardous Waste Management Manual, COMDTINST 16478.

9.4 TANK STRIPPING AND SEPARATOR DISCHARGE

CG Air Stations shall have a waste oil tank for contaminated fuel and other used or contaminated oils. The tank shall be sized appropriately for the number and type of aircraft and type of fueling activity. Air Stations with their own fuel farm will need a larger tank than an Air Station that refuels from trucks. Likewise Air Stations that consume a high volume of fuel daily, such as C-130s, will also need a large tank. The minimum tank size shall be at least 1,000 gallons. Waste oil stripped from the bottom of tanks and discharged from the filter/separator and the oily water separator shall be declared unfit for re-issue if the quality of the fuel cannot be verified or determined by the Fuel King. This waste shall be transferred to the waste oil tank and held there until it can be properly disposed of in accordance with Coast Guard Hazardous Waste Management Manual, COMDT INST. 6260.21B.

9.5 DISPOSAL OF USED FILTERS AND TEST EQUIPMENT

Used filters and test equipment shall be stored in metal containers, sealed with a lid and disposed of in accordance with Coast Guard Hazardous Waste Management Manual, COMDT INST. 6260.21B.
Discarded glass or metal test equipment may be washed with soap and water. Once pieces are free from any oil contamination, they may be disposed of with the regular trash or recyclable wastes.

9.6 DISPOSAL OF USED TEST SAMPLES

Used test samples contaminated with test chemicals shall be disposed of into the waste oil tank. Fuel left over from a flash point test shall also be disposed of in this manner. Samples taken for clear and bright tests may be returned to a fuel storage tank, provided they are recirculated through the filter/separator before being issued to an aircraft.

WARNING: Under no circumstances shall a clear and bright sample be added directly back into an aircraft.

If the Fuel King declares a Clear and Bright sample unfit for further use, it shall be disposed of in the waste oil tank.

9.7 COLLECTION AND SEGREGATION

A direct connection from the fuel storage tanks and service tanks to the waste oil tank shall be prohibited. The only authorized connections should be from the filter separator discharge, oily water separator discharge, and tank stripping connection. Any direct connection shall have a stop/check valve in the line to prevent waste fuel from backing up into the system.

All connections shall have a ball or gate valve at the connection that should be normally closed and only opened when there is oily waste fuel to be delivered to the tank. The oily waste tank shall have a high level alarm to ring at the fuel farm office and at the desk of the Air Station Duty Officer.

The tank should have a full 100% containment system if the tank is above ground.

9.8 COLLECTION CONTAINERS

Collection containers, such as 55-gallon drums, shall be installed in shop areas after informing the ground safety office and fire department of location and anticipated usage. If 55-gallon drums are not available, then appropriate sized 16 or 18 gauge steel drums can be used.
Containers should:

Comply with National Fire Protection Association Codes and the Base Spill Prevention Control and Countermeasures Plan.
Be clean, reusable, easily handled and easily stored.

Be bonded between containers with at least one container or with the drum rack connected to ground (for containers positioned at collection points designated for flammable products with a flash point below 1000 F [380C]).
Have appropriate closure devices to prevent vaporization and/or entry of water. These containers may be mounted on carts, dollies, or trailers to facilitate mobility, safety, and ease of handling.

Mobile carts or bowsers containing flammable products shall be bonded to the product transfer point before and during all product transfer operations.

Trucks, carts, and bowsers used to recover fuel drained from aircraft sumps must be clean. They must have a low point drain, be able to prevent the entry of material other than the product being collected, and be marked for and restricted to a single grade of product. Fuel not suspected of being contaminated can be defueled into a designated refueling vehicle and used to fuel any aircraft.

All containers used for the collection or storage of Re-usable and Waste (R&W) petroleum products shall be isolated from those containing specification products. To prevent accidental aircraft servicing, vehicles used to collect waste products shall be marked conspicuously. These vehicles will not be equipped with single point or other nozzles used to service aircraft. Salvaged or excess fuel servicing vehicles may be retained and used for R&W petroleum products. One 1200-gallon fuel-servicing vehicle, NSN 2320-00-177-6777, is authorized at each Air Station.

1. Do not use assigned mission support aviation refuelers to defuel.

2. Do not use drums, bowsers, product collection tanks, or pits.

3. Do not recover reclaimable, recyclable, or waste petroleum products, except in an emergency.

Storage tanks can be purchased locally. Bowsers and modified tank vehicles may be modified for specific local use.

9.9 DISPOSITION OF FUELS

Fuel removed from any aircraft with recent engine or airframe fuel system problems, possibly related to fuel quality, shall be segregated, and collected in either a designated defueler, a clean storage tank, or other container as "salvage fuel." It will then be sampled and tested to determine if it is usable.

Fuel that tests within the established limits shall be returned to station storage and reissued providing there is adequate filtration and water separation prior to dispensing the fuel. If the fuel is outside the established limits it shall be stored in the waste oil tank and disposed of in accordance with Coast Guard Hazardous Waste Management Manual, COMDT INST. 6260.21B.

10. TRAINING

It is essential to the safety of fuel handling operations that fueling personnel be properly trained in the correct operation of the deadman's fuel shut-off control and in the use of the available fire fighting equipment and extinguishers. Units should not use TAD personnel in fueling operations unless certified by the local Fuel King. Contractors shall certify all employees involved with fueling operations. The certification process shall include a performance-based examination as well as on-the-job observation. Training and certification records shall be kept on file by the Contracting Officer's Technical Representative (COTR).

10.1 ON-THE-JOB TRAINING

As a minimum, units shall provide all personnel involved in fueling operations with the following:

1. A semi-annual informal course that covers the fuel handling procedures described in this document and MIL-HDBK-844 (AS). Any aircraft fueling personnel who are new to the station or to the fueling detail shall attend the course. The course should emphasize MIL-HDBK -844(AS) safety and procedural requirements and procedures applying to local facilities, equipment, and operations. Attendees shall pass a performance-based examination before beginning the duties of a fueling detail member.

2. Training in all the required duties for each of the fuel operator positions based on this Manual and local conditions. These shall include nozzle operator, a fueling operator/truck driver, and an aircraft fuel control panel operator and fire watch. Based on local conditions, units may add a fueling supervisor.

Note: A check off list shall be developed that covers all the required duties of each position for the following fuel operations: Cold Refueling, Defueling, Hot Refueling, Concurrent Fueling, Over Wing Refueling, and Safety.

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3. Units shall maintain unit training records and no person shall perform a fueling function unsupervised unless they have a completed check sheet for that position.

4. Air Stations with a fuel farm shall develop a checklist for the position of Fuel King describing fuel farm operations. No one shall assume the duties of Fuel King until they have completed the checklist (PQS). Supervisors should include adequate OJT time when scheduling transfers and re-assignments.

5. If refueler trucks are assigned, the fueling operator/truck driver must complete a checklist (PQS) for driving the truck. If driven on pubic roads, the driver shall possess a valid state driver's license for the size and class of vehicle being operated. Otherwise, a military license will be sufficient.

10.2 RESIDENT COURSES

The assigned Fuel King must attend a resident course on aviation turbine fuel testing. Shepherd Air Force Base in Texas offers training that meets the requirements of this document. The Fuel King and/or the leader of the Spill Response Team should also attend a resident course on handling HAZMAT. No other resident courses are required.

10.3 CORRESPONDENCE COURSES

Currently, there are no correspondence courses offered by the Coast Guard Institute on Aviation Fuel Handling

10.4 PROFESSIONAL QUALIFICATION SYSTEMS (PQS)

Currently, the Coast Guard has no formalized PQS for fueling personnel. CG Air Stations shall develop a local checklist for each position on the fuel team based on paragraph 10.1 of this Manual. The checklist should include all the requirements of this Manual, particularly those functions of the fueling crew covered in Chapter 7 of this Manual. The local checklist shall account for the equipment, aircraft and conditions found at the Air Station.

11. FORWARD DEPLOYED UNITS REFUELING

Occasionally it becomes necessary for Coast Guard Aviation units to establish a temporary fueling site and landing strip in remote areas. To date this has been confined to Alaska, Mexico and the Bahamas. However, marine disasters and major pollution incidents can also lead to forward deployments for refueling.

11.1 REFUELING FROM A TRUCK

Forward-deployed aircraft will normally be fueled from a truck. The fuel shall be tested visually in accordance with the requirements of paragraph 5.2.4 of this Manual. Daily samples will be taken from the bottom of the truck's tank and given a clear and bright test. The fuel should be recirculated at least once a day through the nozzle.

Once a week or once from every new truck load, whichever is more frequent, samples will be taken for the MK I, MK III and FSII tests. These samples will be sent back to the unit's home base for testing if no test equipment is available at the forward base.

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APPENDIX A
REPRODUCIBLE CHECKLISTS, RECORDS & LOGS

The following checklists, records, and Logs are copies of those illustrated in this Manual, and are provided in this appendix for local reproduction. None of these documents is stocked or accessible in any forms software.

DAILY AIRCRAFT REFUELING EQUIPMENT CHECKLIST

Vehicle or Hydrant #		Meter Reading		Product	Date _____ Time _____
#	Item (See paragrapn 12 3 3 1)	OK	Adjust	Repair	REMARKS
1	Fire extinguishers (in place filed, operable, current inspection tag)				
2	Nozzle stowage dust cover and bonding cable on gravity nozzle				
3	Hook up nozzle to bottom loading adapter or recirculation fitting and check entire nozzle assembly				
4	Hose. Check entire length for cuts, cracks, abrasions, and fuel saturation				
5	Static bonding cable, plug/clip				
6	Leaks (tank, piping valves, pumps, etc)				
7	Emergency valves (operation of controls)				
8	Cleanliness				
9	Battery, radiator, gas and oil levels				
10	Lights, reflectors, rearview mirrors				
11	Drain all low point drains (tank filter/separator, monitor, relaxation chamber)				
12	Exhaust pipe and spark arresting muffler (leaks, cracks, or noise)				
13	Emergency brakes				
14	Drain water from air tanks				
15	Fill hose with full pump pressure and check entire system for leaks				
16	Open nozzle valve, check nose seal for leaks, circulate fuel, and check flow rate				
17	Pump (noise overheating, vibration)				
18	Draw nozzle sample, visually inspect for water, solids and color and record results	Water _____ Sediment _____ Color _____			
19	Record pressure differential reading from filter/separator and monitor	Pump Pressure _____ Filter Pressure Diff _____ Pump R P M _____ Monitor Pressure Diff _____ Flow Rate _____			
COMMENTS					
INSPECTOR'S SIGNATURE		SUPERVISOR'S SIGNATURE			

WEEKLY AIRCRAFT REFUELING EQUIPMENT CHECKLIST

Vehicle or Hydrant #		Meter Reading		Product	Date _____ Time _____
#	Item (See paragraph 12 3 3 2)	OK	Adjust	Repair	Remarks
1	Complete Items 1-17 on the Daily Checklist				
2	Take samples during recirculation and test using CFD and FWD (may be conducted at different time from rest of checklist)	Particulates by CFD _____ Water by FWD _____			
3	Inspect and Clean Refueling Nozzles (SPR and Gravity)	Description of Screen Contents SPR _____ Gravity _____			
4	Inspect tires, brakes, horn, windshield wipers, steering, trailer coupling and electrical wiring				
5	Record pressure differential reading from filter/separator and monitor	Pump Pressure _____ Filter Pressure Diff. _____ Pump R.P.M _____ Monitor Pressure Diff. _____ Flow Rate _____			

COMMENTS

INSPECTOR'S SIGNATURE	SUPERVISOR'S SIGNATURE

MONTHLY AIRCRAFT REFUELING EQUIPMENT CHECKLIST

Vehicle or Hydrant #		Meter Reading		Product	Date _____ Time _____
#	Item (See paragraph 12 3 3 3)	OK	Adjust	Repair	REMARKS
1	Complete daily and weekly checklists				
2	Check electrical resistance of all bonding and ground cables and reels				
3	Inspect and clean all line strainers				
4	Test anti-drive away device				
5	Perform engine spark test				
6	Test maximum flow rate				
7	Test primary pressure control quarterly				
8	Check refueling adapters				
9	Check equipment markings				
COMMENTS					
INSPECTOR'S SIGNATURE		SUPERVISOR'S SIGNATURE			

Periodic and Annual Record

PERIODIC AND ANNUAL RECORD FOR YEAR: _____

Equip type & #	Spring			Summer			Autumn			Winter			Remarks
	OK	Adj	NR	OK	Adj	NR	OK	Adj	NR	OK	Adj	NR	
Brake linings/pads													
Headlight beams													
Wheel inspection													
Suspension inspect.													
Calibrate pumps & meters													
Calibrate press. gauges													
Body inspection													
Paint and decals													

Record Dates Performed					
	Spring	Summer	Autumn	Winter	
Oil change/lubricate					
Tank interior and manhole covers					
Winterize					
Filter element change					
Monitor element change					
Product change & flush					
Brake linings replaced					
Cabin carbon monoxide check					
Test hose end pressure regulator					
Hydrostatic test of refueling hose					
Others (List)					
Inspector's Signature					
Supervisor's Signature					

Filter/Separator or Monitor Pressure Drop Log

FILTER/SEPARATOR OR MONITOR PRESSURE DROP LOG

Vessel Number:	Vessel Type: • Filter/Separator • Monitor
Vessel Location:	Vessel's Rated Flow (gpm):

Date	Pressure (psi)			Measured Flow Rate (gpm)	Calculated Differential (psi) Pressure
	Inlet	Outlet	Differential		